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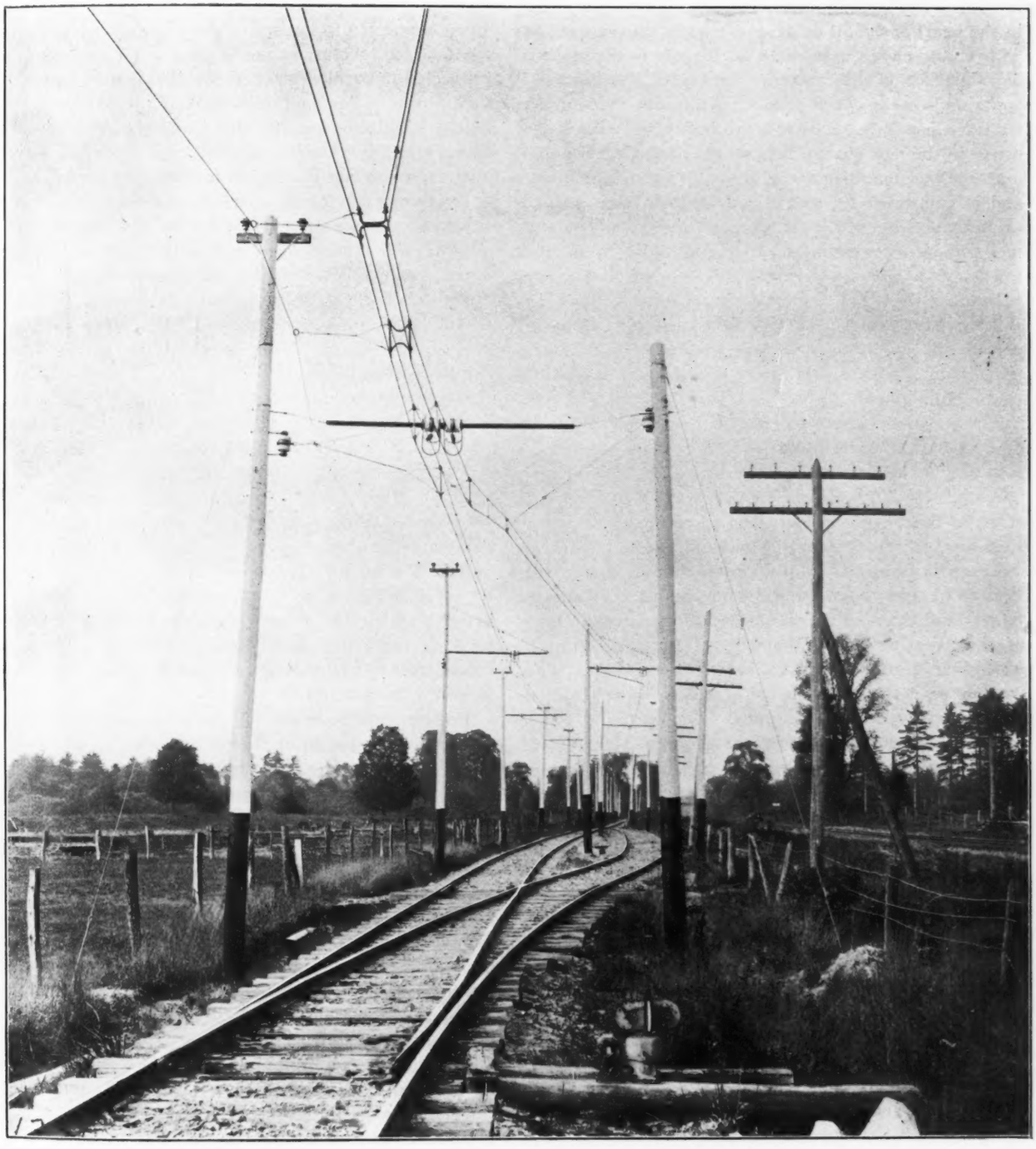


THE WARREN AND JAMESTOWN SINGLE-PHASE RAILWAY. CATENARY OVERHEAD CONSTRUCTION AT TURN OUT

The Warren and Jamestown Single-Phase Railway.

THE electric railway which has recently been opened between Warren, Pa., and Jamestown, N. Y., traverses the valley of the beautiful Conewango Creek, through which the waters of Lake Chautauqua empty into the Allegheny River, and connect the rich "Tiona" oil field of Pennsylvania with the southern shore of the lake. Warren, the southern terminal of the line and headquarters of the operating company, is located at the junction of the creek and the river right in the heart of the oil fields and within the natural gas belt which have contributed so largely to the material development of the western portion of the State. It contains some 15,000 people, while its surrounding territory has a population of 10,000 more within easy access of the new road. Jamestown, at the other end, is a prosperous manufacturing city of 29,000 inhabitants, and is connected by steam and electric road with the attractive resorts of the Chautauqua region whose summer population is estimated at 50,000. The New York towns of Falconer, Frewsburg and Fentonville (the "Gretna Green" of northwestern Pennsylvania,) and Ackley, Russel and Glade, Pa., with their surrounding neighborhoods, bring the total permanent population of the territory adjacent to the new railway to upwards of 65,000 inhabitants.

These figures indicate that the new road is wisely located and that a profitable business is assured. The heavy traffic during the opening weeks of the company's operation gives further evidence that a sure reward is in store for those whose energy and foresight have brought to success this important undertaking.

The equipment is thoroughly modern, comprising horizontal gas engines as prime sources of driving power, and the single-phase alternating-current system of the Westinghouse Company, which is so rapidly extending electrical methods in railway service. This, we believe, is the first instance of a single-phase electric railway operated by gas engines. The current is generated in a power house without a boiler plant, transmitted at a potent, of 22,000 volts over bare copper wires to transformer stations operated without attendants, fed to the central trolley section at 3300 volts, to the terminal sections within the city limits at 550 volts, and is utilized most effectively by as handsome a line of cars as the writer has ever seen.

The track is well constructed. The seventy pound rails are laid on ties of oak and chestnut and ballasted with gravel. They are connected by the type G, form 2, soldered bonds of the Ohio Brass Company, and are cross-bonded at frequent intervals. As the line follows the winding course of the Conewango it possesses many curves, which, together with the grades—one of which is three-quarters of a mile long with an average of 3½ per cent. and a short stretch of 70 per cent.—combine to bring out the qualities of the operating equipment. The sharpest curve has a radius of sixty-five feet. Four turn-outs are now in use but this number will soon be increased to five.

The power house is located at Stoneham, five miles south of Warren, that site having been selected by reason of its proximity to the natural gas pipe lines from which its fuel supply is obtained. The equipment includes two 260-kilowatt, 380-volt, 25-cycle, alternating-current generators of the revolving field type which are direct connected to horizontal gas engines operating at a speed of 150 revolutions per minute. The two units are connected in parallel and run together with remarkable smoothness. The engines were constructed and erected by the Westinghouse Machine Company, and the electrical machinery was furnished and installed by the Westinghouse Electric and Manufacturing Company.

In the new type of horizontal double-acting gas engines the first representative of which is now operating at Warren, the builders have especially sought to construct a prime mover best suited from all standpoints to the American market—uncomplicated in design, simple to operate, substantial and permanent in construction, reliable in its working, and possessing the best economy compatible with the more necessary elements of simplicity. The resemblance to approved steam engine practice is strong; in fact, the engine stands not as an example of radical change in structure but as an adaptation to gas working of the ample steam experience of the builders in Corliss Engines. Symetrical design has been adopted wherever possible, notably in the cylinder casting, with its symmetrical valve chambers, and in the pistons.

Anticipating an almost universal application to electrical working, a relay governing system has been devised which has proven entirely adequate in respect to both regulation and parallel working and which places this type of gas engine upon the same plane with large Corliss practice.

The absolute necessity of accessible parts has largely influenced the design of the engine and resulted in its elevation to such height that all parts are above floor level. Inspection and cleaning, especially of cylinders, is possible without dismantling the engine,

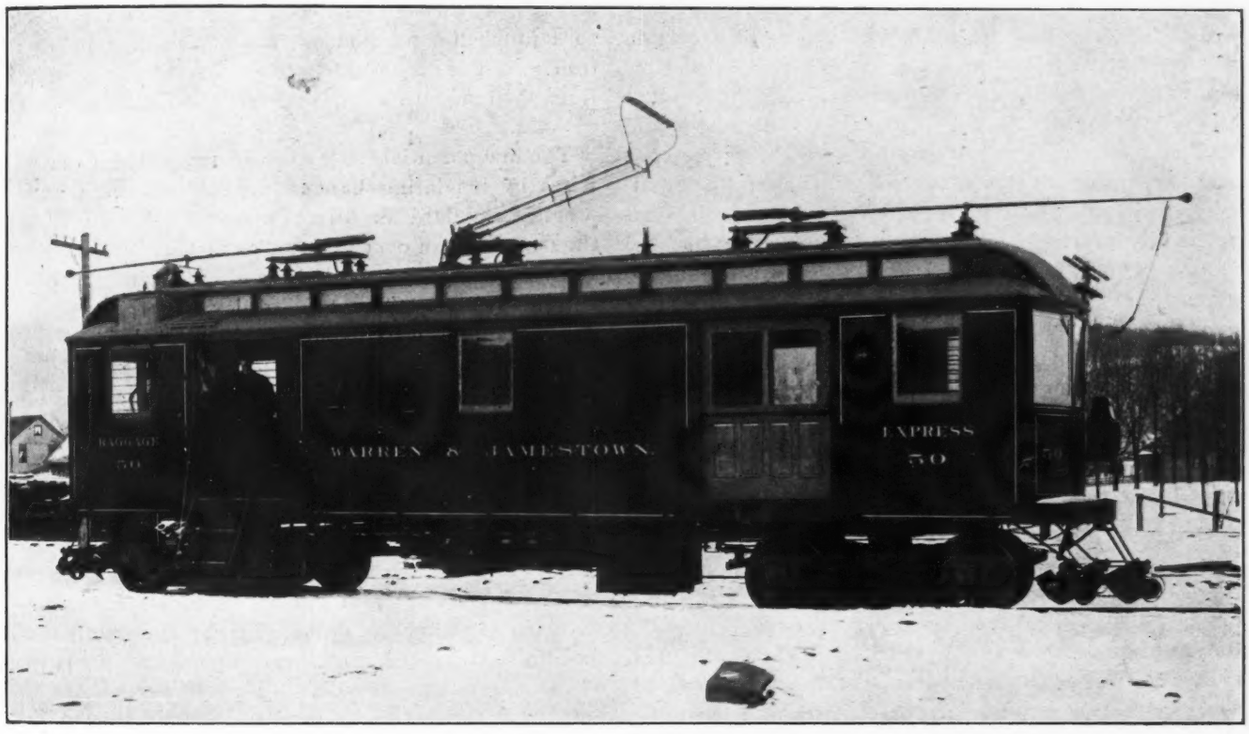
Possibility of injury from neglect has been avoided by providing automatic auxiliaries, both oil and cooling water being delivered under gravity head, cylinder oil by positive pressure and compressed air for starting from storage reservoirs. The starting arrangement has proven particularly efficient, and with only two operations, viz, opening of gates and air valves, the engine automatically starts and comes up to speed under its own ignition without further attention. On large engines considerably less than a minute is required to bring the engine up to speed, and, if desirable, a number of engines in a station may be simultaneously started from one point within this period of time.

To insure the greatest degree of reliability a duplicate system of igniters is employed, with four different combinations in each ignition chamber. Any igniter may be replaced while the engine is in service, and in case of necessity any cylinder may be isolated for repairs during operation.

There are two main generating units at present installed at Warren, with space for a third of equal size—260 kilowatts, 500 nominal horsepower. Single crank tandem units were employed in place of twin tandem units in order to give greater flexibility of operation, the former representing the standard adopted by the builders. The units have solid couplings between engine and generator, and operate in parallel on the station load in precisely the same manner as ordinary steam driven units. The familiar Beau de Rochas, or four-stroke cycle, is used, which, with the tandem arrangement, gives a power impulse with each successive stroke of the engine. Cylinders are twenty one inches in diameter by thirty-inch stroke, the unit running at a nominal speed of 150 revolutions per minute. For this particular service the engine is rated at 470 boiler horsepower, with a maximum of 520 boiler horsepower, giving a 35 per cent. overload capacity on the generator.

The Warren plant was started on October 19, 1905, and has since been in continuous service, averaging seventeen and one-half to eighteen hours per day without developing the least trouble of a serious nature. The only prolonged shut-down was made after a two-month's run for the purpose of examining the condition of the interior of the first unit started. Every part was found to be in perfect working order, without the least evidence of deterioration from wear or excessive strains.

Daily observations of the gas consumption of the plant furnish a striking indication of its extremely high economy. During the month of December, 1905, the cost of gas consumed by the interurban system averaged less than 50 cents per hour, or about 16 cents per car-hour for thirty-five-ton interurban single phase cars. At present the large gas engines operate both interurban and city systems, totaling ten cars. During the week ending January 12th, the cost of gas averaged less than 75c. per hour or 7½c. per car-hour for three interurban and urban plants, the former by the new horizontal and the latter by vertical type engines.



THE WARREN AND JAMESTOWN SINGLE-PHASE RAILWAY. BAGGAGE AND EXPRESS CAR, SINGLE-PHASE EQUIPMENT

Fuel gas is available from several different points and is clean and uniform in quality, averaging from 1000 to 1100 British thermal units total per cubic foot. Gas is obtained at a straight rate of 15c. per 1000 cubic feet, which places the cost of power so far below the usual figure that any other source of motive power is out of the question,

From the generators the current passes through a switchboard of blue Vermont marble panels, completely equipped with apparatus and controlling devices, to raising transformers of the Westinghouse oil-immersed, self-cooling type, which transforms the potential from 380 to 22,000 volts. The two feeders which leave the station are adequately protected by circuit breakers of the fuse type, disconnected switches, low-equivalent lightning arresters and choke coils.

The high-potential lines of No. 6 bare copper wire are carried on porcelain insulators of the Ohio Brass Company, known by the trade name of Locke No. 406, which are supported on chestnut poles. Each feeder connects with a transforming station, one of which is located one and a quarter miles from the Warren terminal and the other one and a half miles from the end of the line in Jamestown.

The transformer stations are made of concrete blocks and are of suitable size to permit a wise arrangemant of the apparatus. They are similarly equipped, each containing two 150-kilowatt. 22,000–3300 volt, lowering transformers of the oil-immersed self-cooling type, which are controlled and protected by fuse-type circuit breakers and disconnecting switches in the high-potential circuits and by oil switches and enclosed fuses in the secondary lines, one of which taps the 3300-volt trolley section while the other feeds the city section of the trolley line through auto transformers along the track which reduce the potential from 3300 to 550 volts. Both high and low-potential feeder circuits are protected by choke coils and low-equivalent lightning arresters which are mounted in the transformer stations. The apparatus is symmetrically arranged, that mounted on one side of the station being exactly duplicated on the other. The two transformers are connected in parallel. Each has sufficient capacity to carry the entire normal load and either may be readily cut out of service.

The transformer stations are operated *entirely without attendants*, and require only occasional inspection. The building is fire proof. It contains no moving machinery or apparatus and has adequate automatic protection, so that there is no likelihood of trouble other than the opening of a circuit breaker because of excessive load. Examination of the illustration on page 170 of one of these stations will show the marked contrast it presents in comparison with the familiar rotary-converter substation of direct-current operation, and exemplifies the system of the single phase system. The high-potential feeders enter the transformer houses through protected openings under the roof. The high-voltage feeder leading to the Jamestown transformer station is carried upon the pole line which supports the overhead construction.

As has been indicated, the trolley line is divided into a central and two terminal sections. The central section is connected direct to the transformer stations receiving alternating current at 3300 volts. A No. 000 figure-8 trolley wire is swung by catenary suspension from a seven-sixteenths inch messenger cable which is carried on heavy porcelain insulators mounted on angle-iron brackets supported on the chestnut poles. The poles measure seven inches at the top and are thirty-five feet long. They are painted white and black and present a very attractive appearance. The white upper portions serve as useful guides to the line of track during the darkness of night.

The overhead construction is particularly fine, as may be seen by reference to the illustration. A nice detail is the slight raising of one trolley wire at switch turn-outs, as indicated in the illustration on page 165, so that the bow trolley easily passes from one wire to the other without impairment of contact. The overhead structure follows the standard practice of the Westinghouse Company, by whom all the material was furnished and installed. At frequent intervals the messenger cable is anchored and steady-strain brackets are used at curves and turn-outs. A few of the curves are constructed with pull-outs.

The central high-voltage trolley line is separated from the terminal section by section insulators.

Within the limits of the terminal cities the trolley lines are supplied with alternating current at the low potential of 550 volts. A feeder from each transformer station leads to three seventy-five-kilowatt auto-tranformers, which are located along the track and connected to a number 000 secondary feeder which supplies the trolley. The auto-transformers reduce the potential from 3300 to 550 volts. They are swung between pairs of poles.

The low-potential trolley line is supported from span wires by insulating hangers, in accordance with the practice standard for direct-current work. In Warren the new cars run over the tracks of the Warren Street Railway Company, which is equipped with the direct-current system. The two trolley wires, alternating-current and direct-current, are suspended side by side from the same spans without appreciably complicating the structure or in any way impairing the service of either system.

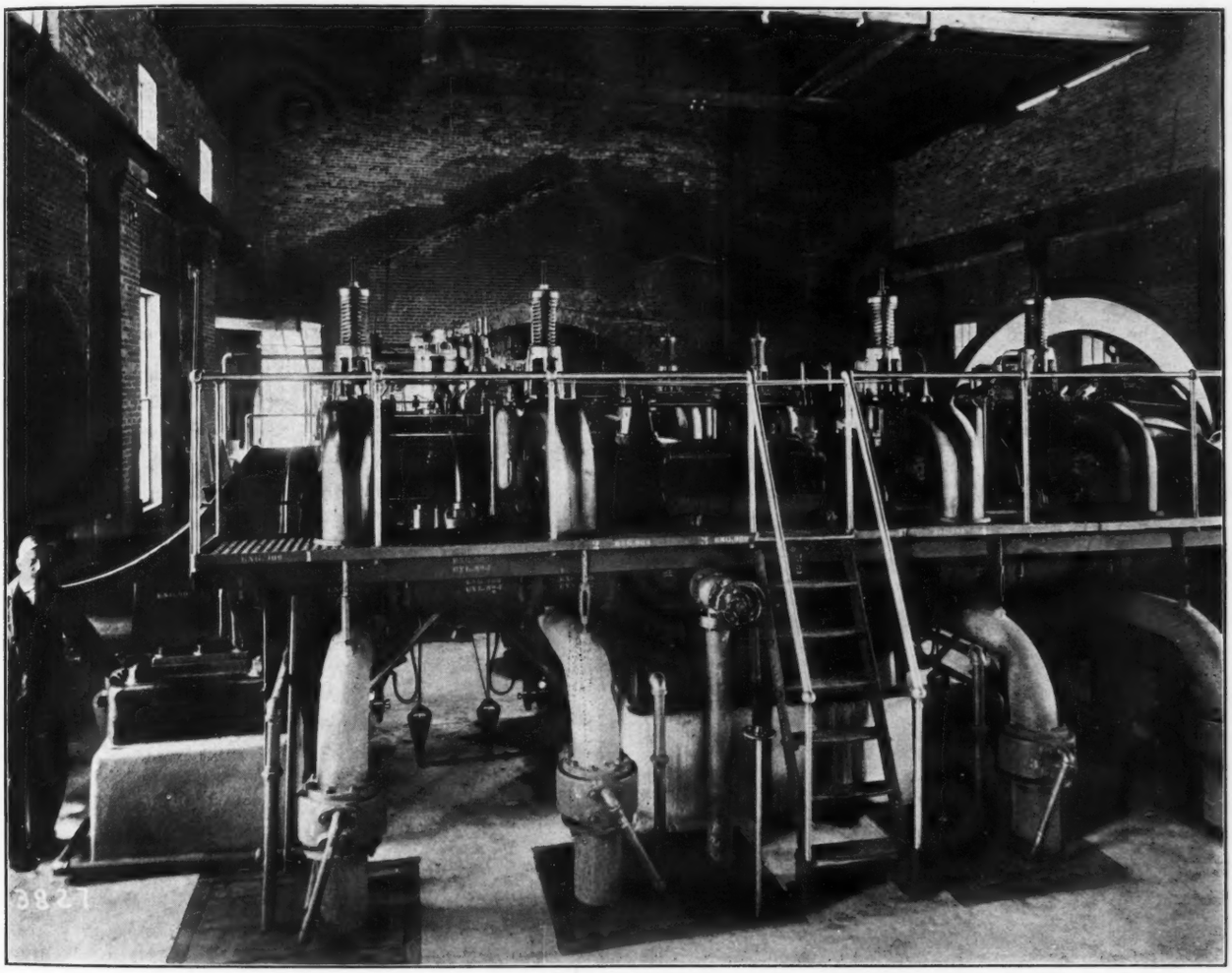
The passenger cars are of the double-end, vestibuled, double-truck type, with thirty-three inch axles. They measure fifty-two feet over all by nine feet in width, and seat fifty-nine people. The seats are set cross-wise along either side of a central aisle. They have high backs and are upholstered in green plush. The cars are supplied with baggage racks, signal circuits and many other modern features. A smoking compartment is provided at one one end and the side. They are finished in mahogany and are decorated in excellent taste.

The operating company has at present five passenger cars and one baggage car, all of which were furnished by the St. Louis Car Company. Each is equipped with four Westinghouse No. 108, fifty horsepower motors of the single-phase, alternating-current, compensating, series type, mounted one on each axle and connected by single reduction gears. The motors are connected permanently in multiple and are operated by the hand controller system by means of taps from an auto-transformer which supplies a varying electromotive force at the motor terminals. The controllers are of the drum type and closely resemble those of direct-current practice, though they occupy somewhat less space. They are mounted upon the platform at each end, so that the car may be operated in either direction. A feature of this installation is its great simplicity and the small space required by the electrical apparatus. It consists only of one bow trolley, two standard wheel trolleys, two controllers, two canopy switches, one auto-transformer,

two preventive coils with resistance, two fuse boxes, one change-over switch and the necessary connecting cables.

The bow trolley is used on the 3300-volt section, the wheel trolleys on the terminal sections of the line. The change-over switch is arrange to cut out the bow trolley and transfer the connections of the wheel trolleys from the low to the high-voltage service taps of the auto-transformer, so that in case of accident to the bow trolley, the wheel trolleys, which are mounted on heavy insulators, may be used on the 3300-volt section of the line. The bow trolley is pneumatically operated, the motors. Hand brakes are supplied. The car, complete but without load, weighs approximately 66,000 pounds.

The motorman has the car under complete control at all times. It accelerates rapidly and without the slighest jar. It runs smoothly and,all in all, seems to operate in a most satisfactory manner. The alternating-current equipment responds rapidly to emergency demands, it being found possible to stop the car in a very short distance by simply throwing the reverse switch. As the controller handles are interlocking the operating drum must first be thrown to the off position.



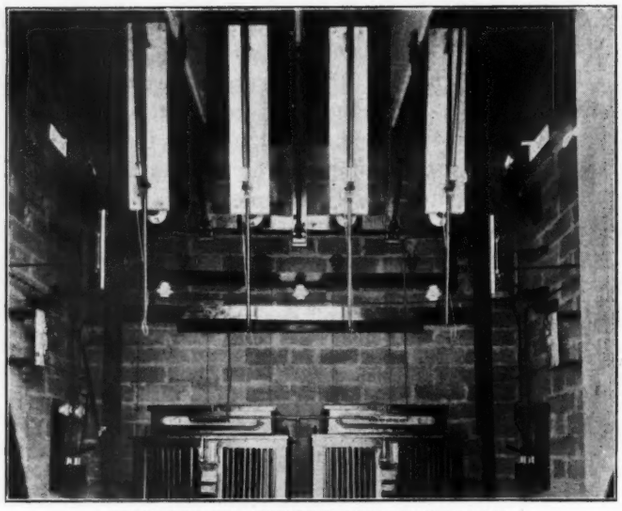
THE WARREN AND JAMESTOWN SINGLE-PHASE RAILWAY. GAS ENGINE

controlling valve being mounted on the platform within easy reach of the motorman. The wheel trolleys are handled in the ordinary way with ropes in which suitable insulators have been inserted to guard against the possiblity of ground when used on a high-voltage circuit.

The preventive coils and resistances eliminate arching at the controller contacts, when passing from one transformer connection to another.

The cars are equipped with Westinghouse straight air brakes operated by means of an air compressor which is driven by a single-phase, series-wound motor of a construction similar to that employed for the main driving

The winter schedule requires the services of two passenger and one baggage car. Commencing at six o'clock in the morning cars leave either end of the line every hour and a half; this service continues until 11:30 p. m. The run of twenty-two and a half miles is made in one hour and ten minutes, each car laying over about twenty minutes between trips. There are fifty-three stations along the line at which stops may be made; their average run each way includes about fifteen stops. The two cars pass at a switch near Ackley, about the centre of the line. The maximum running speed is fifty miles per hour. The complete run from terminal to

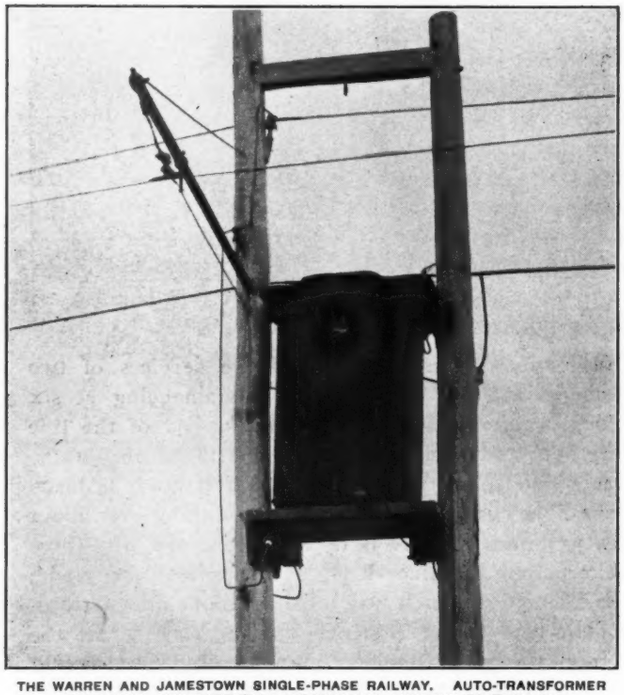


THE WARREN AND JAMESTOWN SINGLE-PHASE RAILWAY
INTERIOR OF TRANSFORMER STATION

terminal without stops has been made in forty-seven minutes.

The change from high to low-voltage trolley is easily accomplished. As the car approaches the terminal section the motorman releases an air valve, thereby lowering the bow trolley which automatically closes down and locks in place. After passing the section insulator the conductor places the wheel trolley on the line in the ordinary way. The change-over may be made without stopping.

Under present arrangement the car is run two days with a mileage of 246, and is then brought in for inspection. The bow trolley shoes are found to give a life of approximately 10,000 miles. So far there has been no indication of undue wear of the trolley wire, nor has there been any trouble with the overhead structure.



THE WARREN AND JAMESTOWN SINGLE-PHASE RAILWAY. AUTO-TRANSFORMER SUPPLYING LOW POTENTIAL ALTERNATING CURRENT TO TROLLEY IN JAMESTOWN

The present service of the Warren and Jameston Street Railway Company requires a total of but ten employees, outside of the general offices and the car crews. It is made up of four men in the car barns, three power house attendants, and one line-man. An additional line-man is occasionally borrowed from the Warren Street Railway Company. There are no attendants in the transformer stations.

The officers of the company are: D. H. Siggins, president; H. M. Preston, vice-president; S. Q. Smith, secretary.

Mr. Siggins is assisted in the management of the property by his son H. A. Siggins, a director of the company and general manager of the Warren Street Railway. To President Siggins the community in which he lives is indebted for exceptional transportation facilities. His clear mind early recognized the possibilities of electric traction, and to his commercial courage and untiring energy is due the organization and success of the Warren Street Railway Company, whose lines were constructed and have since been operated under his personal supervision.

RESEARCH WORK IN PORTLAND CEMENT.

THE Prussian Government and the German Society of Portland Cement Manufacturers offer premiums to the amount collectively of 3000 marks (about £150) for essays on the processes which take place in the hardening of hydraulic cements. The essays which take as general subject matter the demonstration of properties and of the induration process of calcareous hydraulic cements, synthetically, analytically, microscopically and mineralogically as applied to hardening in air, fresh and sea water, may deal with all or any of the following questions:

1. To prove whether silicic acid, alumina and oxide of iron with lime as crystalloids in stable proportions or as colloids in varying proportions.

2. To prove whether double combinations result between silicic acid, alumina and oxide of iron with lime, and in what manner these substances take part in the hardening process.

3. Consideration of the swelling phenomena which accompanies the hydraulic hardening.

4. Consideration of the influence of the temperature and the duration of the burning process on the different kinds of hydraulic cements.

5. Properties of puzzolana and its hardening with lime; beginning with silicic acid, as the most active and prominent puzzolana, alumina, oxide of iron and manganese, independently and in combination with silicic acid, either as natural or artificial puzzolana. The papers must be written in German and must be submitted under a *nom de guerre* to the Ministry of Public Works, 80 Wilhelmstrasse, Berlin, on or before December 31, 1906. The papers will be adjudicated by a committee comprising Professors Van't Hoff, Schiebe and Fresenius, Drs. Michaelis and H. Passow, and Messrs. E. Crammer and F. Schott, together with officials of the Royal Testing Station, Berlin.

THE HISTORY AND DEVELOPMENT OF THE STEAM TURBINE.

BY HARRY Y. HADEN

THE more or less rapid advent of the steam turbine into the field of high class prime movers has served to create the greatest interest in the minds of engineers to-day, and it is already the verdict of many

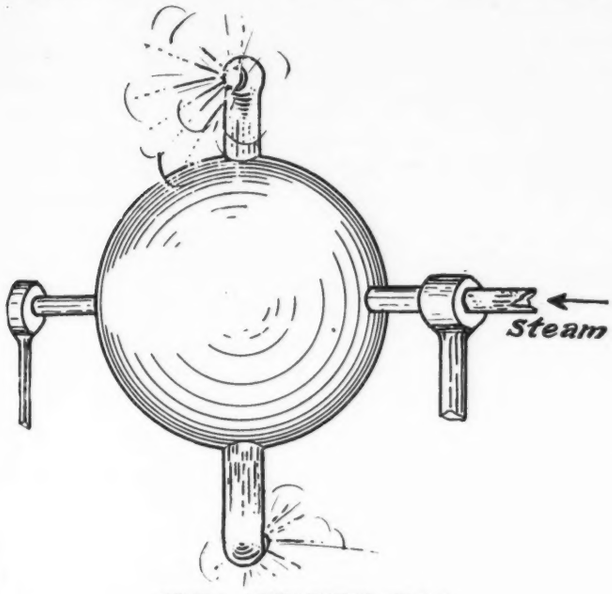


FIGURE 1. HERO'S TURBINE, 150 B. C.

authorities, that, given certain operating conditions, the steam turbine is the best investment of the two, that is, in first cost and installation combined with the general efficiency from coal pile to bus bars. Indeed, one of the latest verdicts rendered by Henry G. Stett in a paper read before the American Institute of Electrical Engineers entitled "Power Plant Economics," is a striking one. In his summary with regard to the comparison of reciprocating and turbine engine he says: "The steam turbine has an inherent economy 20 per cent. better than the best reciprocating engine plant, not so much due to its higher thermal efficiency as to a variety of causes shown in Table II. For explanation here, it might be stated that Table II has reference to maintainance and operation with special emphasis on 'engine room mechanical labor, water and lubrication.' "

Whatever the position of the steam turbine is to-day, it has certainly benefited the power house economies in general, for it has stirred up the reciprocating engine manufacturers towards producing higher economical results.

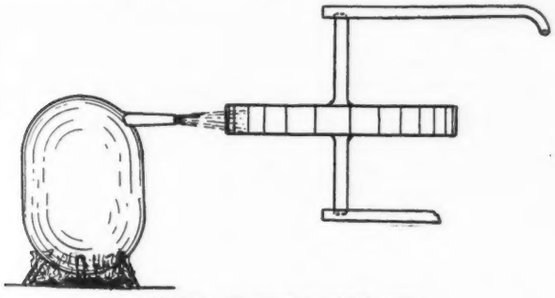


FIGURE 2. BRANCA'S TURBINE, 1629

It is revolutionizing the designs of electrical machinery on account of the high speeds involved, and in place of the immense generator frames with their low speed rotors, one sees units that looked dwarfted in comparison, but which are nevertheless capable of sustaining heaviest overloads at good efficiency while requiring a much less elaborate, and therefore less costly foundation.

It has also stimulated the condenser manufacturers to so increase the efficiency of their apparatus as to be able to sustain high vacuums with greater ease than hitherto, and therefore raise the total efficiency of the plant. Reciprocating engine practice doesn't call for such high vacuums as the steam turbine, due in most part to the fact that the increase in size necessary in the low pressure cylinder to allow for the further expansion means an increase in the friction and radiation surfaces and consequent condensation that go some way towards offsetting the gains obtained from the further expansion, whilst the turbine benefits down to the last tenth of an inch in as much as the buckets or last sets of buckets are revolving in a lighter medium.

The fact that a larger condenser and more cooling water are necessary to obtain the higher vacuums is

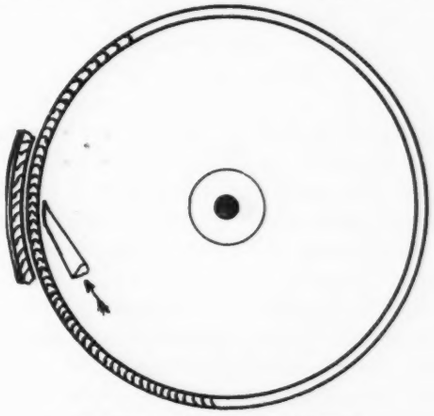


FIGURE 3. PILBROW'S FIRST TURBINE

sometimes used as an argument in favor of the reciprocating unit, but if it can be shown that the steam turbine can produce a kilowatt of electricity, particularly under ordinary running conditions, that is, under various load ratings, with no more steam than the reciprocating engine when both are operating with the same steam pressure, superheat and normal vacuum, then the advantage will certainly appear to lie with the turbine. Later on the author hopes to give results from reliable tests made under normal steaming conditions where the resulting economies when operating under various loads will be in evidence.

Without wishing to go any further into the pros and cons of the case, it is sufficient to say that the whole question offers very interesting observation, and covering as it does so many considerations, it is unlikely that any general agreement may be arrived at so soon.

Before commencing to describe the various steam turbines that are in service to day, it is considered advisable to follow its history, and it is the intention of the author to devote the remainder of the first article to the same.

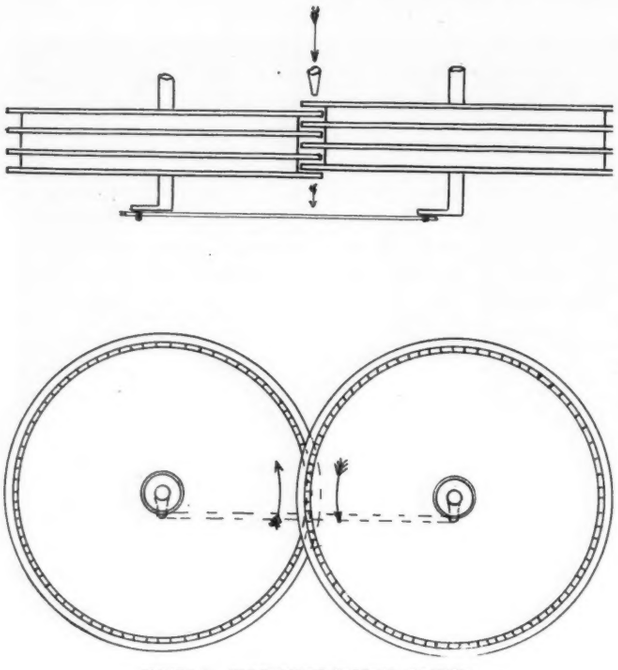


FIGURE 4. MULTI-STAGE TURBINE, PILBROW

The first conception of the steam turbine has been ascribed to the Egyptian philospher Hero in the second century B. C. As will be seen from the diagram in Figure 1, this was a reaction turbine, the motion of the globe being obtained from the reaction of the steam in issuing from the two jets. Whether this is authentic or not is however a matter of small moment. It is probable that the steam engine would appeal to the earliest mind rather in the form of a turbine than a reciprocating motion.

Figure 2 shows the idea of a turbine used by Branca, an Italian architect in the year 1629, having a nozzle and one wheel as its essentials, it might be termed the fore-runner of the De Laval turbine. It is said to have been used in connection with the pounding of drugs.

In 1784, both Watt and Wolfgang de Kempelen were granted patents in England relating to steam turbines.

In 1791, an English engineer devised a machine whereby he utilized the reactive force of steam in issuing from a rotating elbow pipe.

One of the most interesting of the early turbines is the design patented by Pilbrow. He appears to have found out and made use of the beneficial results due to the expansion of the steam. His simple turbine is shown in Figure 3 and consisted of a single wheel carrying a set of buckets on which steam impinged issuing from a nozzle placed inside the wheel, the steam after striking the blades and having its motion changed passes into fixed guide blades and is led away. His interesting turbine is embodied in the design shown in

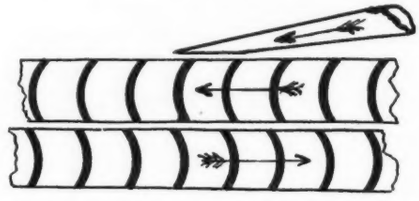


FIGURE 5. DIAGRAM SHOWING BUCKETS IN PILBROW'S MULTI-STAGE TURBINE

Figure 4, where it is seen he uses a succession of wheels coupled together, as shown, and thereby having their circumferences going in alternate directions. By this means as in some respect similar to the Parsons turbine, he was able to utilize a lower vane speed and not sacrifice its efficiency. The position of the nozzle and blades is seen in detail in Figure 5. It will be noticed by the shape of the nozzle, as shown, that he had not conceived the idea of the expanding nozzle, which discovery was left to Dr. Gustav De Laval of Sweden.

About 1848 Robert Wilson of Greenock took out patents in connection with both axial and radial flow turbines, the former of which being given in Figure 6, in which it is seen that he uses the moving and fixed blade similar to the Parsons turbine in its idea. The

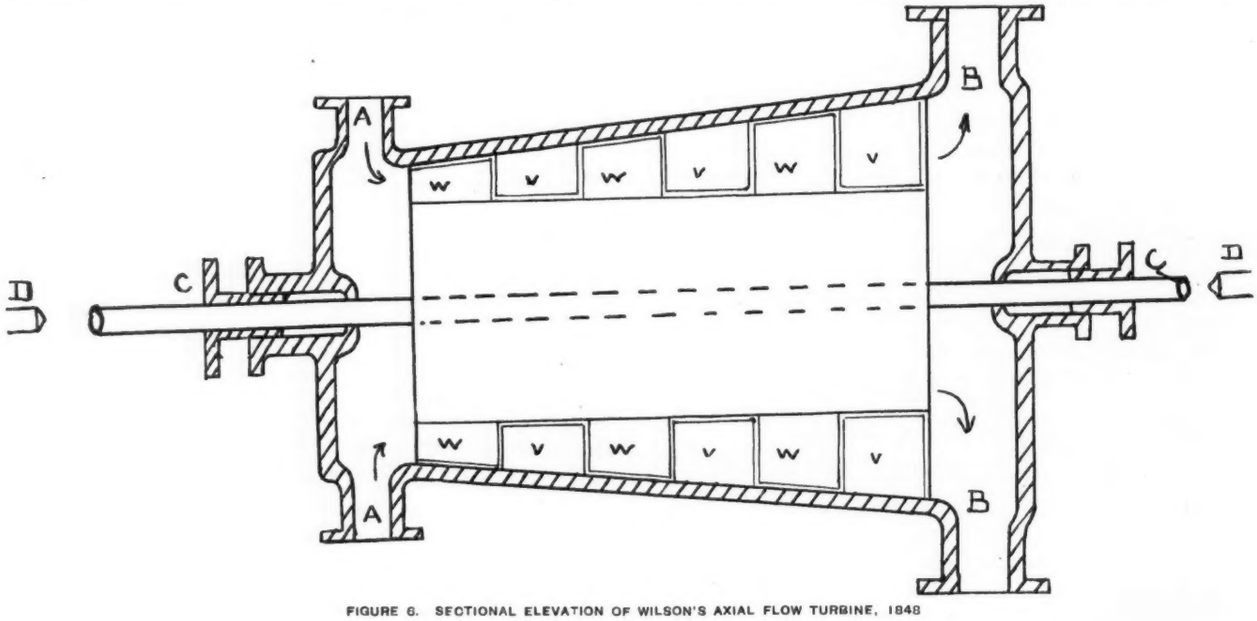


FIGURE 6. SECTIONAL ELEVATION OF WILSON'S AXIAL FLOW TURBINE, 1848

steam enters at *A A* and passes through the rotation blades *WW* and then through the fixed blades *VV* attached to the casing *H H* and so on to the exhaust *C C*. The shaft passed through stuffing boxes *B B* and the resultant end thrust due to the reaction of the steam was taken by the pivot points at *D D*. This appears to be the first steam turbine designed in the larger sizes, as one of them is shown in the specifications to be over nine feet in diameter.

In 1853, Tournaire, the French mining engineer, presented to the French Academy a description of a many stage reaction turbine, incidently drawing attention to the enormous speeds attained by steam and the consequent high blade velocity that would be required in a single wheel to properly utilize these velocities. He is also said to have suggested the use of helicoidal gearing which is such an important factor in the De Laval of to-day.

Figure 7 shows a turbine of rather original design experimented on by Professor Hewitt. The action of

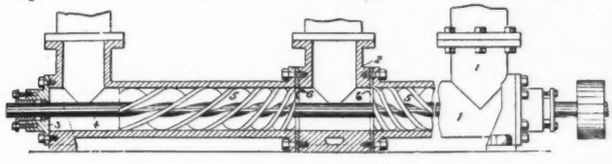


FIGURE 7. HEWITT'S SCREW TYPE OF MOTOR

the steam is obvious. Before the steam strikes the screw it passes through a perforated plate as is shown by numbers 6, 6. It seems that the turbine was never a success, and that the steam simply rushed through without giving any motion to the screw.

In 1883 he brought out his first steam turbine which was used in connection with a cream separator, later on developing into its present form.

In April of the year 1884, The Honorable Charles A. Parsons took out his first patent relative to the turbine of his name. The turbine was of rather different design to the engine of today, and the essentials of it are shown in Figure 8, which is a diagram sketch showing in prominence, the main feature *A A* is a spindle carrying on it a collar *B*, and reduced down at both ends to *CC*. On the spindle *AA* are placed a number of rings retained in place against the central collar by the two nuts *D D*. Attached to the casing are another set of rings *F F*, and both these sets of rings carry the blades so arranged that the ones attached to the moving rings *E E* have their path between each set of blades attached to the stationary blades *F F*.

The action is as follows: The steam enters the central chamber *GG* and traverses the path between the alternately moving and fixed blades in a direction indicated by the arrows and exhausting into the chambers *H H*. As the steam flowed in both directions there was very little end thrusts, and consequently this turbine was not equipped with balancing pistons. The author has been trying to obtain records as to the economies of this turbine but unfortunately cannot find reliable figures.

About the year 1904 Professor Ra•eau of Paris commenced in conjunction with Sante, Harle et Cie experiments on the turbine of his name, and much valuable data in both theory and practice have been given to the steam turbine world by Professor Rateaus' researches.

Shortly after this time C. G. Curtis of New York began work on the turbine of his name, which was soon after taken over by the General Electric Company and developed to its present state.

This brings us to the steam turbine of the present day and it is proposed that the construction and discussion of same should be left to succeeding articles. The turbines which the author proposes to enlarge upon are the four most prominent in present use: viz, the Parsons, De Laval, Curtis and Rateau.

All turbines whether fluid or gas may be divided into two primary classes: viz, axial and radial flow, depending on the direction of the path taken by the fluid or gas through the turbine. When the path is parallel to the path of the axis it is termed an axial flow turbine, and when at right angles to the axis, a radial flow turbine. Thus, an example of a radical flow turbine is given in Figure 3, while all the examples following are axial type. As a matter of fact the mechanical difficulties present in the former type practically bar it from the field.

CLASSIFICATION

Perhaps the most important classification is the "Action" and "Reaction" type. If no expansion of the steam takes place from the time the steam leaves the guide vane or nozzle till it issues from the bucket, or in other words, if the pressures are the same, then it is an "Action" or "Impulse" turbine. Examples of action turbines are De Laval and Rateau.

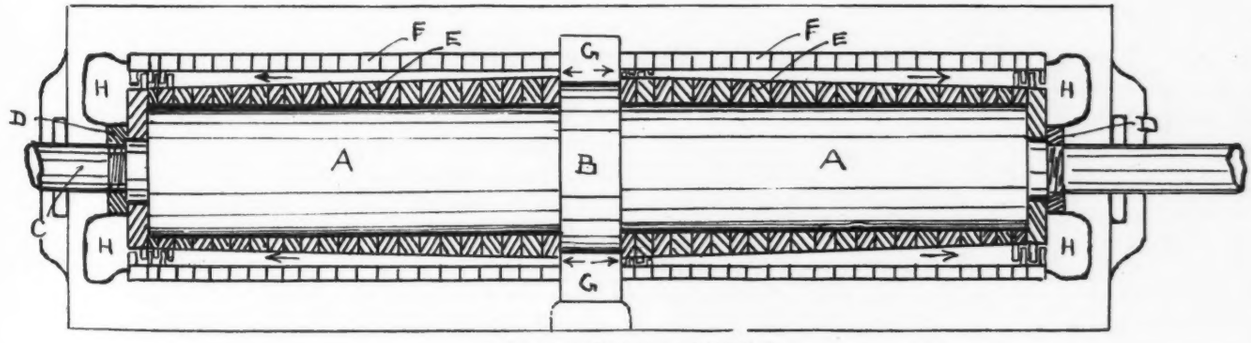


FIGURE 8: FIRST TURBINE OF PARSONS

On the other hand if expansion takes place either in the space between the guide vanes or in the buckets themselves, then the turbine is of the "Reaction" type. The best sample of a reaction turbine is the Parsons.

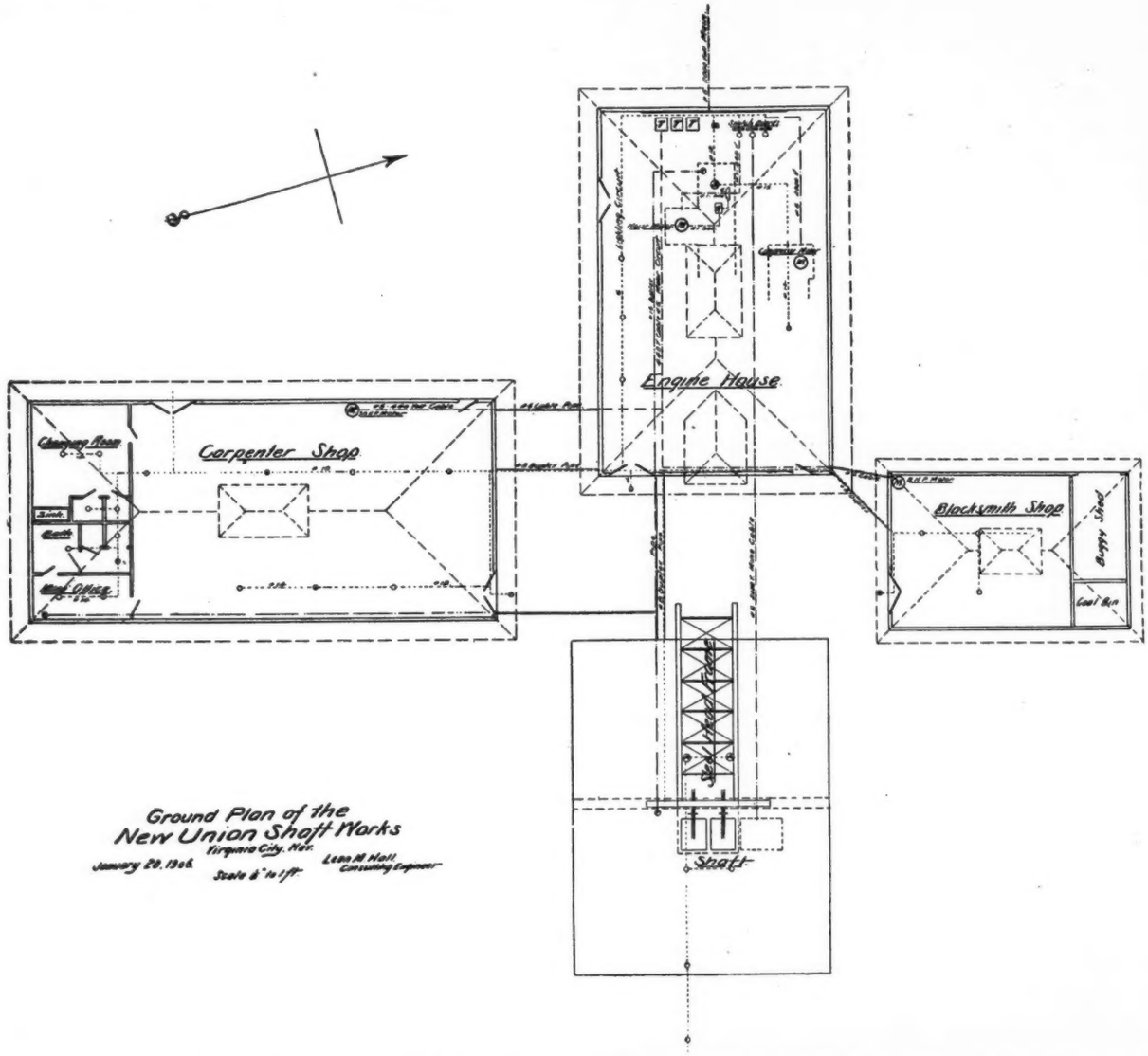
A further classification may denote the number of sets of blades, wheels or "Stages." A "Single-stage" turbine where only one set of buckets carried on one wheel are used, such as in the De Laval type, and a "Multi-stage," where a series of wheels are utilized, such as in the Parsons or Rateau. It has been sugested to further classify the multi-stage turbine into "Pressure stage" and "Velocity stage," depending on whether any expansion takes place during each stage. For instance, in a Rateau turbine no expansion of the steam takes place during its passage through the buckets, as it is a purely impulse turbine, hence it would be termed a "Velocity stage" turbine, while the Parsons type, where continual expansion takes place, would be designated as "Pressure stage."

In the next article it is suggested to discuss in detail the Parsons and De Laval type.

MODERNIZING THE COMSTOCK LODE

BY LEON M. HALL

AFTER many vicissitudes and years of patient toil the plans for modernizing the comstock Lode are assuming a definate shape and the end of all dead work is now in sight. Just how well these plans have matured cannot be better illustrated than by a brief description of the new Union Shaft works and a comparison with the old.



The Union Shaft Company was a combination of the Sierra Navada, Union Consolidated and Mexican mining companies for sinking and equipping what was formerly the North Consolidated Virginia shaft in order to work the above mentioned companies from a common base. This shaft was one of the pet schemes of John W. MacKay and James G. Fair and they erected and equipped what was probably the finest and largest mining plant in the world.

The shaft was sunk to a depth of 2750 feet and about $2,500,000 extracted therefrom. The main hoist consisted of a double direct acting engine with 30 x 24 inch

UNION SHAFT FROM THE EAST, OLD PUMPING ENGINE CYLINDER IN FOREGROUND

cylinders. The reels when full were about sixteen feet in diameter and held 3000 feet of eight inch flat rope. The pump hoist consisted of a double 10x24 engine geared 5 to 1, and this was used to handle the heavy pumping machinery. The pump was of the Cornish pattern and consited of a double line of 18x120-inch plungers. These were operated by means of an Oregon pine pump rod twenty inches square and 2700 feet in length. The engine was compound condensing with cylinders 64x78 inches and 100x99 inches. The flywheel was thirty-six feet one inch in diameter and weighed 115 tons. The boilers consisted of twelve return tubular boilers 54x16 inches arranged for wood burning. The consumption of fuel at the shaft was sixty cords per day at an average cost of $11 per cord.

This shaft and machinery were operated until the mines were flooded in 1885, since which time work was carried on in a desultory manner until about a year and a half ago, when the works were unfortunately consumed by fire. At the time of the fire an effort was being made to repair the shaft and open the lower levels. The work done upon the shaft was almost entirely lost at the time of the fire, inasmuch as it was burned and caved to the 900 foot level.

It may be mentioned to the credit of the Union Shaft management that this property has been entirely rehabilitated and put into first class, modern condition without exceeding their regular monthly allowance.

The new works, as shown by the accompanying photographs, are arranged in the form of a cross and consist of three separate corrugated iron buildings and a steel head frame of pleasing and economical design. The engine house is 36 x 62 x 20 feet and contains, besides the 100 horsepower electric hoist, a 75 horsepower two stage Ingersoll-Sargeant air compressor and all transformers, switches and meters.

The electric hoist is of the balanced tail rope type with an auxiliary sinking drum. It is speeded to 1000 feet per minute with single deck cages and has a capacity of about 500 tons per day from a depth of 2000 feet. This hoist is in successful operation and I do not hesitate to say that in so far as speed, control, reliability and efficiency are concerned it is the most perfect mechanism of the kind I have ever seen in operation. Accurate tests show a total efficiency of over 72 per cent, and when hoisting rock the brake is seldom or never used. The motor is a special 100 horsepower, 460-volt, General Electric variable speed motor, operating at 450 revolutions per minute.

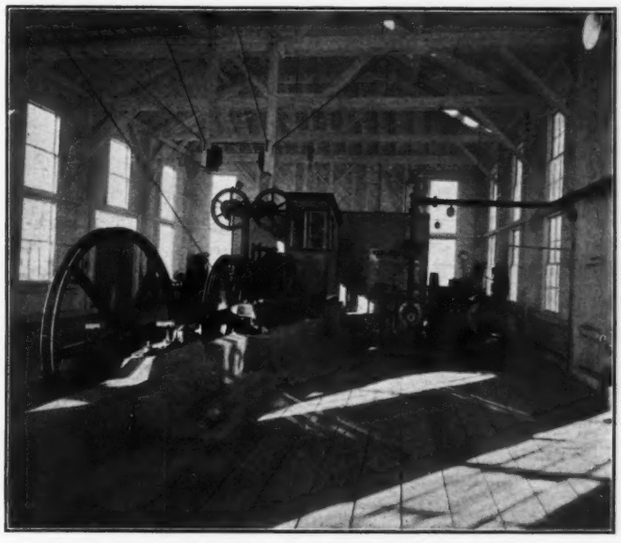
The air compressor, A class, J. C. Ingersoll-Sergeant, 19¼ x 12 x 12 inches, is driven by a 75 horsepower 2000-volt Type C. Westinghouse motor and is connected to the compressor by means of a Morse chain drive.

Three 40 kilowatt, Type H, General Electric transformers are used to transform the current from 2240 volts to 460 volts for the hoist and other surface motors. These are located in the west end of the engine house, together with all meters and switchboards.

The carpenter shop south of the shaft is of corrugated iron and is 36 x 72 x 20 feet in size. The building contains the mine office and changing rooms. The carpenter shop is equipped with a 46-inch swing saw driven by a 20 horsepower General Electric, Type K, 440 volt motor. All mine timbers are framed with these saws so that carpenter work is reduced to a minimum.

The blacksmith shop is directly north of the carpenter shop, is of corrugated iron and is 26 x 40 x 14 feet in dimensions. This shop is equipped with one forge, a two horsepower motor and American blower, besides a hand drill press and bolt cutter. All of these buildings are lighted with electric lights and all wiring between them is carried in underground circuits.

The steel head frame was manufactured by the Wellman-Seaver-Morgan Company and is of unusually pleasing design. The frame is sixty-nine feet in height and is carried upon a thirty-inch box girder forty-two feet in length, the ends of which rest upon masonry walls on each side of the shaft. The struts are bolted to



UNION SHAFT, COMSTOCK, INTERIOR OF ENGINE ROOM

concrete foundations. The frame has withstood an eighty mile gale and snow storm and vibrates very little under load.

The shaft has been entirely retimbered from the surface to the 900 foot level, at which point the fire stopped. Below this point the shaft has been cleaned and repaired to the 2050 foot level. We have, during the past month, opened a station on the 2000 foot level and have started a cross-cut to intersect the vein now being opened on the 2150 foot level of the Con-Virginian and Ophir mines. This ore body has already produced about $2,000,000, and as much more will probably be extracted therefrom during a similar period of time.

A four-inch compressed air pipe extends from the surface to the 2600 foot level, and a No. 4-3 conductor 2500-volt steel armoured cable is used to transmit light and power to the underground workings.

A metallic telephone circuit connects each building and the carman's station with all points in the shaft. A one inch cold water pipe extends from the 1600 foot level, the water to be used for the drilling purposes. Three inch Sergeant auxiliary valve drills are used underground so that it is not saying too much when we state that this shaft is the most thoroughly equipped mining property on the coast.

The plans for the entire plant were prepared by the writer and the works erected under the able superintendance of J. A. McDonell.

ISOLATED PLANT ENGINEERING.*

BY PUTNAM A. BATES.

TO obtain the full advantages of an isolated plant, it is essential that each piece of apparatus installed shall be the most suitable for the conditions under which it will have to work and that the plant when considered as a whole will be capable of manipulation and operation in such manner as to produce a maximum efficiency at all times and require a minimum of labor for operation.

To accomplish this the entire plant must be analyzed from the delivery of the fuel, to the supply of current at the switchboard. It is not sufficient to follow the pattern of some other plant which is supposed to be operating satisfactorily, and make the necessary changes in size of units to suit the load conditions.

A careful study must be made of the functions which it is intended that the plant shall perform and the type of plant which will be best suited to perform these functions in the most efficient and economical manner.

The first and most important question which must be determined is that of the type of prime mover to be selected.

Until very recent years the commercial limitations were such as to present, what may now be considered, but few types from which to select.

The plant in which the prime mover was other than the reciprocating steam engine was a distinctive exception, therefore few cared to give much consideration to the internal combustion engine using gas or oil or to the steam turbine.

Hence so far as the power producing apparatus in the plant was concerned, the questions which were at that time of prime importance, were whether the expansion in the steam engine should be single or compound, whether a condenser should be used, and what would be the most suitable pressure under which to operate.

This state of affairs does not exist today, as the internal combustion engine has been brought forward as a prime mover and its improved economy in fuel consumption over that of the reciprocating steam engine justifies its recognition and consideration.

For commercial use the internal combustion oil engine has not been developed in the same way that has the gas engine, and except in the case of small units and in a few special instances, its use has not thus far received the consideration which must be given the latter.

The lack of uniform angular velocity and the uncertainty in action and high maintenance cost were objections to the use of internal combustion engines for electrical purposes which recent developments have removed. Their inability to carry heavy overloads, however, together with the fact that their range of economical load is practically limited to between 50 per cent. and full load are defects which thus far have not been satisfactorily eliminated and which would be decided drawbacks in many plants.

This difficulty may, perhaps, be best overcome by the installation of a storage battery plant to take the fluctuations in the load on the station, but this is not always desirable or commercially practicable, and would usually add considerably to the first cost of the generating plant. In sections of the country where cheap gas can be obtained the gas engine will show a much greater economy than any of its competitors, and recent improvements in gas producer and supply apparatus have brought the first cost of installation of gas plant equipments down to a point where it compares favorably with that of first-class steam plants using reciprocating engines.

The delay in the development and use of the gas engine has been largely due to the difficulty of making all elements of engine and gas generating apparatus reliable in operation and to the absence of an efficient and inexpensive gas producing apparatus.

The introduction of the steam turbine has worked greater changes in the power plant design than any other item. It has made it possible to take advantage of certain features of steam generation looking toward greater economy of power production which, due to inherent characteristics of the reciprocating type of steam engine, it was nearly or quite impossible to make use of before the advent of the steam turbine. It is true that since the coming of the steam turbine into the field of power generation from steam, advances have been made in the art of reciprocating engine construction which make it possible to take advantage of those features to some extent, but not in so simple a manner.

* A paper read before the Columbia University Electrical Engineering Society, by Putnam A. Bates, consulting electrical engineer, 42 Broadway, New York.

The introduction of the steam turbine has carried with it the development of the super-heater and an effort on the part of the engineers to improve the efficiency of the furnace by providing more complete combustion of the gases. It has stimulated a higher development of condensing apparatus and it forced electrical manufacturers to design high speed generators, thus greatly reducing the floor space required per kilowatt capacity with the consequent saving in real estate, buildings and foundations, and making it possible to greatly increase the capacity of the generating unit over what appeared to be the practical limit for the reciprocating engine type.

Besides these direct developments which the steam turbine has brought about, it is also fair to place to its credit the renewed interest which it has created in the improvement of power plant efficiency.

In determining upon the type of power plant equipment best suited to the requirements and conditions under consideration, many points must also be kept in mind, which at first thought might be considered as outside the problem, but often prove to be the factors which, by the manner in which they are met, determine whether the plant will be a money saver or a money loser.

The reason for this condition is that most isolated plants, and many central stations, are required to perform not only their primary function of producing and delivering power, electrical or other, but must in addition supply other needs of the buildings, communities, or town which they serve, and the efficiency with which these combined conditions are met, rather than the efficiency of the plant considered merely as a power producer, is the factor which often determines the value of the plant from a commercial standpoint.

Thus it is not sufficient merely to determine under certain conditions of load and environment whether, for example, a kilowatt-hour of electrical energy may be generated more economically by the use of water wheel, internal combustion engine or steam engine, and in the case of the last named type, whether the plant shall run condensing or non-condensing; but, before deciding on this point, careful consideration must be given to the question whether, by the use of some particular type of apparatus, some other end may not be served which will add to the revenue of the plant or increase the saving which it is able to bring about, and at the same time accomplish its primary function with a reasonable degree of economy.

The problem of the sub-division of the equipment into the most suitable units is also a very important one, and the manner in which it is solved, frequently determines the usefulness of the plant from a commercial standpoint. Many plants, which under different conditions would produce good results, are daily losing money for their owners or are shut down and represent an investment entirely wasted, simply because this question of the proper sub-division into units was lost sight of or ignored.

It is not easy to determine this point beforehand, but by a careful study of the conditions and a comparison with others of a similar nature, it is possible to pre-determine the character of the load very closely.

Take, for example, a large office building, club house or hotel. A good method of pre-determining the load conditions in such a structure is to draw up, in tabular form, a schedule of all the rooms and apparatus requiring current for light or power in the building, and opposite each set down the estimated amount of current required in or by it during each of the twenty-four hours or less that the plant will be required to operate. A curve plotted from the totals obtained in this manner will be of great assistance in choosing the size and number of units to be installed.

If, however, it is possible, as is sometimes the case, to determine the conditions by actual observation or test, this should always be done, as, if properly done, it is much the more accurate method.

It frequently happens, particularly where the power plant is to be installed in and serve some building, the primary object of which is other than the housing of the power plant apparatus, that limitations of space must be met which greatly modify the conditions and narrow the field from which to choose the apparatus to be installed.

This condition is frequently chargeable at the door of our friends the architects, but the fact remains, and the condition must be met in the best possible manner and with as little sacrifice to poorer economy as may be.

The comparatively small amount of space required by the high speed reciprocating engine which has of recent years attained a high state of development and is able to show very good economy and regulation, is a great help to the engineer in overcoming the difficulties brought about by cramped engine rooms, and frequently makes it possible to solve what at first seemed a hopeless problem in a very satisfactory manner.

It sometimes happens that the conditions are such that the installation of a single large unit would result in the highest economy of operation, but even under these conditions it is seldom wise to install such a unit unless it can be safeguarded by a storage battery or some other auxiliary source of power, as the crippling of such a unit, for even a short time, would usually result in a loss far in excess of the saving which the single large unit is able to show over the cost of operation of a plant equipped with two or more units. This is true not only of the engine or generating unit, but also of the boilers or other primary source of energy, and to some extent of the auxiliary apparatus of the plant.

On the other hand a division into but two units, unless each is of sufficient capacity to carry the full load, is little if any better, as in the event of one unit having to be shut down the remaining one would rarely have sufficient capacity to carry the whole load even for a few hours, unless the capacity of each unit is considerably in excess of one-half the total required to carry the load,

in which event both units must operate continuously under conditions of loading very unfavorable to high economy. The use of two units, each of which is capable of carrying the full load continuously, is usually to be recommended only where the load is nearly or quite constant, as it requires that one large unit should remain idle continually, and under less favorable load conditions the resultant economy of operation would not be so good as might be obtained with a greater sub-division.

A division into three units of the same size and type, each having sufficient capacity to carry one-half the full load, or into two large and one small, or one large and two small units, any two of which could, if necessary, carry the full load, makes an arrangement which in all but very large plants is usually productive of a high degree of economy together with a reasonable degree of immunity from shut down and a comparatively low first cost.

In choosing the units the advantages in the way of spare parts and repairs, which are to be gained by the use of as few different sizes and types as possible, must not be lost sight of, and where for sufficient reason it is deemed advisable to install units of different types, it should be determined beyond all reasonable doubt that these units will operate in conjunction in a satisfactory manner.

Without entering into the pros and cons of direct vs. alternating current, suffice it to say that the same general principles may and should be applied in the selection of the type of dynamo and of the voltage at which the current shall be generated.

Thus, in the case of a group of shop buildings already equipped with motors for electric drive, it would ordinarily be unwise to select electric generating apparatus producing current of a different nature or voltage from that with which the motors were built to operate, as the choice of such apparatus would entail a heavy investment in new motors and add greatly to the interest tax properly chargeable against the power plant.

As another example, consider the case of a large office building requiring electric current for lights and for elevator and ventilating fan motors. In such a building the load conditions are rather unfavorable in as much as continuous or nearly continuous service is usually required while the peak of the load is high and of short duration, and during the balance of the twenty-four hours the load is comparatively light and very irregular.

These conditions would seem to indicate the advisability of installing a storage battery plant, but, unfortunately the space limitations are often such as to put this entirely out of the question or to make it impossible to arrange a suitable battery room.

Under these circumstances it is well to consider the advisability of making use of the public electric service from the street mains as an auxiliary source from which to draw at times of very light load, making it possible to shut down the plant at such times, or in case of a break down.

In this way the first cost of the plant may be reduced by the elimination of a small unit which might otherwise be required to carry the load during the night and a portion of the day, and by a reduction in the amount of spare apparatus which would otherwise be necessary to provide against accidental shut down.

In order, however, to take advantage of this means of saving, it is necessary to ascertain and comply with the rules and regulations with which the lighting company necessarily restricts its customers in the use of the current supplied by it.

It may be readily seen, therefore, that this one factor frequently determines the type of current and the voltage at which the generators shall operate, aside from any consideration of the relative advantages of one system or voltage over another, in the abstract.

And so it goes through the entire plant. Each particular item must be considered from all sides, and the pros and cons carefully weighed before a decision is reached as to the use of any particular type of apparatus to meet certain requirements or as to whether a sufficient saving will result from the use of some piece of apparatus to warrant the expense of installing it as a part of the plant.

It is the care and thoroughness with which those principles are applied which determine, largely, whether a plant will prove a credit to its designer or not.

In order to bring out more clearly the practical application of what has been said to particular cases, let us consider that of an isolated power station for a manufacturing plant consisting of several buildings spread over the greater portion of a city block and located about six or eight hundred feet from the river.

This plant consists of several machine shops for doing both heavy and light work, a forge shop, a pattern shop, a storage loft for patterns and an office building.

Power for the operation of machinery in the various shop buildings was originally supplied by two steam engines located at different points in the works, each supplied with steam from a single boiler near by and each driving a long line of shafting by means of a belt.

In time these engines became worn out and were discarded and a number of electric motors were substituted for them, a semblance of individual drive being installed in some of the shops. Current for these motors and also for some lighting was obtained from the public service mains in the street, and distributed from a switchboard in one of the shop buildings.

The two old boilers, however, were retained and kept in commission as the steam was needed for driving a couple of small air compressors in the boiler plate shop, a high pressure hydraulic pump used to furnish water under pressure for the operation of hydraulic tools in the forge shop, a steam-hammer, also in the forge shop, and for heating the various buildings.

This arrangement was obviously uneconomical both in operating cost and in space occupied, and it was therefore decided to install a central power generating plant where all of the power required by the works could be economically generated, and without occupying valuable space in the shops with boilers, feed pumps, coal piles or non-productive machinery.

The space alloted to the power plant building was approximately thirty-five feet wide by sixty feet deep running back from the street to one of the shop buildings.

These then were the conditions, and the problem was how best to meet them to secure the greatest economy of operation and the greatest return on the necessary investment.

The first question to be answered was with regard to the type of plant to be installed.

The high pressure steam-driven hydraulic pump and, if necessary, the steam driven air compressors could be replaced by electrically-driven apparatus, but no suitable substitute for the steam hammer has, as yet, been marketed and no form of heating is so well suited to the conditions which prevail at these works as that using direct radiation from steam or hot water.

As the advantage gained by the operation of the steam hammer, and the saving which could be accomplished during about six months of the year by the use of exhaust steam for heating purposes, far outweighed any possible saving in the cost of power production which internal combustion engines might perhaps be able to show in comparison with steam-driven apparatus, the latter type was chosen in preference to the former.

The next point to be decided was the total capacity required and the most advantageous sub-division into units.

In order to obtain as much information as possible which would serve as a guide to help in determining this question, careful observations were made of the current consumption at different times of the day and under different conditions, and of the size, number and character of the various motors and tools in the shops. A careful study was also made of the coal, water and electric bills for the preceeding five years in order to ascertain as nearly as possible how the load conditions changed from month to month and year to year.

As a result of this analysis, it was decided to install three electric generating units, two of sixty, and the third of thirty kilowatts capacity, and a single steam-driven air compressor, it being unnecessary to provide a reserve machine of this type as the temporary crippling of this machine would shut down only a small portion of the works and would not interfere in any way with the other portions.

The type of prime mover and the relative advantages of operation with or without condensers came up next for consideration.

As has already been pointed out, the advantages to be gained in this instance by the use of exhaust steam for heating purposes were very great, and as the steam required for this constituted a very considerable percentage of the total amount of exhaust steam from the engines, the increased economy of power generation to be obtained by the use of a condenser, even if condensing water were cheaply available, would obtain only during the warmer months of the year and would not, for that reason, show a sufficient return on the additional investment necessary to warrant the installation of an equipment of condensing apparatus.

The rather limited amount of floor space and the desirability of not enroaching upon the second floor of the power plant building any more than was absolutely necessary, as this space could be used to advantage for manufacturing purposes, eliminated the horizontal slow speed type of prime mover from consideration in connection with the electrical generating units required for this plant, more especially as the air compressor must necessarily be of the slow speed type of engine and no vertical machine of the proper capacity could be found.

A careful comparison of operating efficiency, first cost, floor space occupied and general suitability of the various types of high speed reciprocating engines and steam turbines, showed a very decided advantage in favor of the vertical compound reciprocating engine as applied to the conditions already mentioned.

Having reached this point in the solution of the problem in hand, the steam generating equipment may now be taken up for consideration, and the total capacity, and sub-division into units, the type of boiler to be used, and the nature of the auxiliary apparatus required decided upon.

The nature and amount of the load has already been determined in connection with the choice of the engine units, and to determine the total boiler capacity required it simply remains to ascertain the amount of steam which these engines will consume when furnishing the requisite power, as determined by the manufacturers guarantees, and to add to this the amount of steam which will be consumed by the steam-hammer. In this manner it was found that three hundred horsepower in boiler capacity would be sufficient, the horsepower rating being based upon the well recognized standard of 34½ pounds of water evaporated per hour from and at 212 degrees F.

The steam boiler is a much more flexible unit than the steam engine or electric generator, it being possible to force it far beyond what would be a safe overload for a standard engine or dynamo, and to obtain a reasonably good efficiency from it even at light loads. This fact, together with the small amount of floor space and the desirability of reserving some space for future enlargement of the boiler plant, lead to the choice of two boilers each of 150 horsepower set in a battery.

It still remained to determine the type of boiler best suited to the requirements.

The ability to make steam quickly, together with the desirability of carrying a high pressure with as little risk as possible, and of using super-heating steam in order to obtain the best possible economy from the steam engine units and obtain the full advantages to be gained by the use of compound steam cylinders, lead to the choice of inclined water tube boilers with four inch drawn steel tubes and wrought steel headers, equipped with super-heaters, also of the tubular type, placed at the top of the boiler setting and between the first and second pass of the furnace gasses.

A cross drum type of boiler with fourteen-foot tubes was used in order to make it possible to set the boilers across the building, which arrangement was the most economical of floor space and lent itself best to the steam piping arrangement, and at the same time to remove and renew tubes as occassion should require.

Having reached this point it became possible to proceed with the design of a suitable building for housing the apparatus to be installed.

The building decided upon is a two-story brick and steel fire-proof structure having the boiler and engine room on the first or ground floor, and a 100 ton steel coal bin on the second floor, the remaining portion of the floor being available for manufacturing or other purposes.

A steel plate smoke stack four feet in diameter and with its top 125 feet above the boiler room level also rests upon the second floor, and is connected with the flue openings of the two boilers by means of a steel plate flue and breechings.

Coal is delivered by means of a chute from the sidewalk to a bucket conveyor running from a pit on the first floor, into which the chute opens, to a point above the coal bin on the second floor. This conveyor is entirely enclosed and provided with a spout at the top by means of which the coal is deposited near the center of the bin. A motor on the second floor drives the conveyor by a belt.

The boilers are located in a room by themselves, the side wall of the setting being carried out to form a partition wall between the engine room and the boiler room. This arrangement necessitates the cleaning of one of the boilers from the engine room, but was necessary in order to obtain sufficient room for a possible future increase in boiler capacity.

The coal bin is located directly over the firing space in front of the boilers and has two pockets, from the bottom of each of which hoppers are carried down to a height of about five feet above the boiler room floor and terminates in valves.

Under these hoppers a small coal charging car runs on rails set in the cement floor, and from this car the furnaces are supplied. This arrangement makes it unnecessary to carry any coal upon the floor of the boiler room and therefore possible to keep this portion of the plant in a neat and cleanly condition.

Owing to cramped space and the nature of the soil, which prevented excavating to any depth, it was not possible to make any special provision for the removal of ashes, even if the quantity of these were sufficient to warrant the necessary expense, which would be involved in providing for this in any other way than by hand, through the ash pit doors.

The boilers are built for a working pressure of 200 pounds per square inch, although, for the present at least, but 150 pounds will be carried, and are each equipped with a super-heater designed to increase the temperature of the steam, before it leaves the boiler, 100 degrees F. above the temperature of saturated steam at the same pressure.

Economizers were not installed for the reason that it was found that a sufficient amount of surplus exhaust steam would always be available for use in a feed-water heater to maintain the temperature of the feed water at about 200 degrees F.

The feed-water heater is of the open type, consisting of a cast iron shell with copper drip pans or trays at the top, over and through which the feed water percolates, and a settling tank and filter at the bottom. A branch from the exhaust pipe connects with the feed-water heater, and the steam enters through an oil separator and mingles with the cold water trickling over the trays. In this manner the entering steam gives up its latent heat to the incoming water, is condensed, and unites with the water, and the resultant hot water decends to the settling tank below to be drawn out and forced into the boilers by the feed pumps. No steam outlet is provided for the heater, only such quantities of steam being drawn into it as are required to replace that previously condensed.

Two boiler feed pumps are installed, one being steam-driven and the other electrically driven.

The former is a duplex ram pattern brass fitted pump, having a normal capacity of about twelve gallons of water per minute, and is intended as a spare unit to be used in case of emergency or at times when steam is required but the electric plant is shut down.

The other is a triplex plunger type pump, having a normal capacity of eighteen gallons per minute, driven through a train of gears by a three horsepower variable speed motor. The controller of this motor is provided with both armature and field resistance, so proportioned that it is possible to reduce the speed of the motor, and consequently the output of the pump, from the maximum to one-half by cutting out resistance from the motor field circuit, and from one-half to one-quarter by introducing resistance in the armature circuit. The pump is also provided with a by-pass from the discharge to the suction, by the opening of which the amount of water delivered by the pump may be still further reduced when necessary.

Although this pump was much more costly than a steam pump of the same capacity, its much higher economy of operation amply warranted the additional expenditure.

Steam is delivered from the boilers into a five-inch heater running across over the boilers and through the dividing wall into the engine room, where it enters a five-inch steam main from which the various steam-driven units are supplied.

This header and main are made up of steel pipe flared out at each end over the face of the flanges to the bolt circle, and the face finished off to receive copper gasket. This construction reduces the possibility of leaky joints to a minimum. The steam main is carried on brackets along the wall and near the ceiling.

The exhaust main consists o eight-inch pipe with screwed flange joints, and is carried along the side wall of the engine from directly under the steam main and up in one corner to a point above the roof. An oil separator is installed beyond the point where the last exhaust pipe enters the main.

The three generating sets are installed in a row along one wall, and on the other side of a central aisle is the air compressor, the electrically-driven boiler-feed pump, space for an additional electrical generating set and a controlling and distributing switchboard.

The air compressor has compound steam and two stage air cylinders, and is equipped with a reheater between the steam cylinders and an inter-cooler between the air cylinders.

Steam for each of the engines is taken from the top of the steam main by means of an elbow and a long radius bend, thus providing for expansion and contraction of the pipe and making steam separators on the engines unnecessary.

The generators are direct current, 240-volt, compound wound machines. The primary reason for the choice of this current and voltage was that all the motors installed throughout the works were wound for that, and the use of it makes it possible to take advantage of the public service as an auxiliary should it ever prove desirable to do so.

The lighting is taken care of by means of a three-wire system, fed from a rotary balancer installed near the switchboard. This arrangement was considered preferable to the use of a 240-volt, two-wire lighting system for the reason that this higher voltage does not lend itself well to the operator of many of our higher power illuminants, such as the arc lamp, so useful in the economical lighting of large enclosures.

The switchboard consists of seven panels of marbleized slate mounted upon an angle iron frame, and set three feet from the wall. There is a generator panel for each of the three dynamos, a total output panel, an equalizer or balancer panel and a lighting feeder and power feeder panel.

Each of the generator panels is equipped with a single lamp bracket, an ammeter, a field rheostat, a three pole switch, the middle pole of which performs the functions of an equlizer switch, and double pole, double arm, laminated contact circuit breaker with carbon breaks.

Upon the total output panel are two single lamp brackets, a power ammeter, a light ammeter, a recording ammeter for the total current, a two pole, double throw switch, controlling the total current, one side being connected to the bus bars and the other left blank for possible future connection to the public service, a recording watt-hour meter for registering the total amount of electrical energy generated, a double pole power switch, and two smaller double pole switches, one controlling the supply of current to the equalizer panel and the other the circuit feeding the electrically-driven boiler-feed pump.

The equalizer panel is equipped with two single light brackets an ammeter for indicating the amounts of current flowing in the neutral wire of the three-wire system, and its direction, and a voltmeter for indicating the voltage on either side of this system—each of these instruments has the zero in the center of the scale and reads to the right and left—a voltmeter switch, the balancer field rheostat, a three pole, double throw switch for the control of the supply of current to the lighting feeder panel, one side being connected to the bus bars and the other left blank for possible future connection to the public service, a switch and starting box for the control of the balancer and a double pole circuit breaker. This circuit breaker is rather peculiar in that the actuating coil is connected to the neutral wire from the balancer, while the blades are connected to the positive and negative wires, respectively, of the three-wire system. By this arrangement an excessive unbalancing of the lighting circuits which would overload the balancer would trip the breaker and open the outside legs of the system, thus protecting the balancer from overloads without running the risk of an abnormal side increase of potential of one or the other of the system, which would, to say the least, be detrimental to the life of the lamps.

Each of the feeder panels is equipped with two single lamp brackets and a number of feeder switches from which feeders are run to various points through the works.

On top of the switchboard a large illuminated dial voltmeter and a potential indicator of the same size and type are mounted. These are connected to a voltmeter switch on one of the generator panels, and to the main bus bars respectively.

From this switchboard the generation of the current and the distribution throughout the works is controlled.

A somewhat knotty problem was presented in connection with the air compressor.

As you know, whenever air or any other gas is compressed heat is generated, and the greater the compression the higher the temperature to which the gas is raised. This is what occurs in the air cylinders of the compressor, and unless this heat is removed, the temperature to which the cylinder walls will attain will be destructive. To over come this it is customary to provide water jackets around the cylinders, and, in large two cylinder machines, intercoolers as well.

The amount of water necessary to cool the air compressor of the machine in question was estimated at fifty gallons per minute. The only available supply of water was from the city mains and the cost of this amount from that source was too great to be considered.

To overcome this difficulty it was finally decided to install a cooling tower upon the roof through which the water could pass, after becoming heated in the jackets of the compressor, and be cooled and used again.

A small tank was placed on the second floor to which a water pipe terminating in a ball cock was run and in the engine room below, near the compressor, a small

motor-driven rotary pump was installed. A water pipe was run from the tank to the suction inlet of the pump and from the discharge outlet of the pump another pipe was run and connected to the inlets of the water jackets. From the jacket outlets a pipe was carried to the top of the cooling tower and from the collecting pan at the bottom down to the tank on the second floor.

A by-pass and waste pipe was also provided which make it possible to allow the water to run to waste when desired, as, for example, when it becomes necessary to clean or repair any of the parts.

By this arrangement only sufficient water is drawn from the street mains to make up the loss by evaporation which is about five per cent, and the cost of the necessary electrical energy is trifling compared with the saving accomplished.

The total investment necessary to accomplish this result was about equal to the cost of the water for one year if this water were allowed to run to waste after being used in the jackets.

It has been my desire to outline to you a few of the actual conditions which consulting engineers have to meet in dealing with this particular problem which has been selected as our subject for this occasion. I have endeavored to give a clear exposition of the principles governing isolated plant engineering and to develop them in accordance with the best practice of the present time.

To treat the subject as comprehensively as possible I have confined myself to conclusions which are based on results obtained from actual conditions found in plants of the character referred to.

And in conclusion I may say, to those of you who contemplate having to deal with power plant design, that it will be well to remember that with all of the conditions which affect such plants you will seldom find two alike. You must therefore, in each case, make a complete analysis of the result to be accomplished, and a careful study of the means at your command.

ELECTRIC POWER FOR OIL WELLS.

NINETY per cent. of the oil well fires are started, says *Mines and Minerals*, by the drills or the pumps operated by oil, gasoline or steam engines. When the point of the drill crushes through the substratum of hard rock which holds the oil in its subterranean reservoirs, the pressure from below sends the liquid up in great geysers which spray around in all directions. Any fire within a distance of fifty feet is apt to cause ignition, and the great spout of oil once fired becomes a most destructive agent.

The use of electricity in the oil regions of this country has grown very slowly, and comparatively few drills and pumps are thus operated. Notwithstanding this the danger from fire causes insurance rates to stand at almost prohibitive rates, and in some instances no insurance whatever can be obtained on the property or the machinery. In California, Texas, Kansas, Indian Territory and Oklahoma hundreds of thousands of dollars annually go up in burning oil wells, which, while presenting a very spectacular sight, is hardly consistent with modern methods of industrial progress and economy.

The use of electric motors for driving oil drills and oil well pumps has extended rapidly in parts of Europe where German and French engineers have studied the problem.

The first wells to be drilled by electric motors were those in Roumania. Nearly seven years ago the first installation was attempted for experimental purposes in order to reduce the fire risk and to secure economy of operation by bringing all the wells in the region under the control of a single central generating station. The Dutel Company, which owned considerable valuable oil property, installed a central station at a distance of a mile and a half from operations. The total capacity of the station was only 200 kilowatts, but it was sufficient to operate the drills in the whole region. Besides the drills two sets of motor-driven pumps were set up in the district. The motors were of the three-phase type, operated at 300 volts. The current was carried over wires from the central station on overhead poles temporarily erected. The remarkable elasticity of this system immediately proved of value to the company. The pumps and drills were quickly shifted from one part of the field to another within a total radius of two miles from the generating station. All possible fire risks were removed, and the company up to date has had no explosions or ignitions of wells. The saving in this way alone is sufficient to recommend the system to oil drilling companies. By this method there was a further saving in efficiency and cost of operation, and the company is now increasing its generating station and widening its field of operation.

The advantages obtained in better regulating the oil production in Europe by means of electrical generating stations for extensive fields are equally promising in this country. Fires in the oil fields of this country are fully as numerous and destructive as in Russia, and the waste of energy by using individual steam units or oil engines for each well is a factor of no small importance. Where steam pipes are used for carrying steam to distant wells the loss through condensation is considerable, and its remedy is more easy to suggest than in coal mines. The adoption of electricity for different kinds of mining operations is one of the interesting questions of the day, but if there is one field that should show especial benefit from this it is in mining for oil. And this particular field has shown the least responsive appreciation of the opportunities offered by the central station idea from which electric power can be run on overhead wires to hundreds of different wells.

So far as can be accurately ascertained there are 112 independent telephone systems in Canada, distributed as follows: Ontario, 34; Quebec, 28; Nova Scotia, 24; New Brunswick, 17; Manitoba, 3; Saskatchewan, 2.

MT. RAINIER, MT. SHASTA AND MT. WHITNEY AS SITES EOR METEOROLOGICAL OBSERVATORIES.

BY ALEXANDER G. McADIE.

IN 1903 an ascent of Mt. Whitney was made by the writer, and a report upon its availability as a site for meteorological research published in the *Sierra Club Bulletin*, June, 1904. The elevation, 14,515 feet, then determined barometrically, was thirteen feet higher than the value determined by precise levels in August, 1905, by the U. S. Geological Survey, R. A. Farmer, topographer.

During the present summer ascents of Mt. Rainer and Mt. Shasta were successfully made. Mercurial barometers, a boiling point thermometer, wet and dry bulb thermometers and other apparatus were carried to each summit. The barometers were the same as those used at Mt. Whitney. Check readings were made at San Francisco and at Portland; and simultaneous readings for sea level conditions at Seattle, Tacoma, Portland, Spokane, Red Bluff and Eureka, through the courtesy of the officials in charge of the Weather Bureau offices in those cities. Professor J. N. Le Conte,* of the University of California, checked the readings at both peaks, and Messrs. Franklin, Knapp, Hutchinson, Gardner, Gould and Elston assisted.

Camp at an elevation of 5500 feet was made in Paradise Valley on the southern slope of Mt. Rainer July 16–31. Leaving camp July 24th, the night was spent at Camp Muir, and on July 25th the ascent completed. Starting from Sisson, Mt. Shasta was climbed on August 4–5, 1905.

*Professor Le Conte also checked the readings made on summit of Mt. Whitney in 1903.

The co-ordinates of the peaks are—

Rainier..... 46° 51′ 5″ N., 121° 45′ 28″ W.
Shasta .....41° 24′ 28″ N., 122° 11′ 49″ W.
Whitney .....36° 34′ 33″ N., 118° 17′ 32″ W.

The elevations are—

Rainier.....14,394 feet, approximately.
Shasta.....14,200 feet, approximately.
Whitney.....14,502 feet, true.

These peaks, it will be noted, are so located as to offer an ideal opportunity for studying weather conditions on the Pacific Coast. They stand like three sentinels in a stretch of seven hundred miles, at such distances from one another and so related to the orography of the coast that an almost unparalleled opportunity is afforded for obtaining a cross-section of the general storm tracks and prevailing wind direction at levels extending almost from the sea to a height of 4420 meters (14,500 feet). A chain of high level observatories is particularly desirable on the Pacific Coast, inasmuch as the general climatic conditions are essentially different from those of other sections of the country, being in fact materially modified by the proximity of the ocean and the extremely diversified topography of the coast. As stations for research and original investigation of problems connected with the physics of the atmosphere, these peaks are exceptionally well adapted. The most northern, Rainier, lies directly in the mean storm track, and permits of experimentation upon cloudy condensation in the free air, rainfall and snowfall throughout the entire gamut of pressure and temperature conditious. The most southern peak, Whitney, is located in a region probably the driest in the United States. With nearly half of the sensible atmosphere below its summit and a minimum amount of

TAKING MEASUREMENTS FOR ALTITUDE ON SUMMIT OF MT. RAINIER

water vapor present, no better site could be found for investigating the part played by the atmosphere in the absorption of solar energy. The discoveries made at all lower level observatories, giving as they must results obtained after the passage of the radient energy through a considerable stratum of atmosphere, can only be completely verified by comparison with the results obtained at levels approximately above the sensible atmosphere.

Again, in connection with the radio-activity of air, it is believed that conditions are very favorable for experiments on the ionization of the upper air strata and the part played by electrons as nuclei for condensation.

But chiefly in connection with the practical question of improving the forecasts over the western half of the country it is important that observatories should be established on these peaks. The Pacific Coast is essentially a region of marked climatic contrasts. Within short distances great differences are found. In other words, local climates are prevalent to a marked degree in this Western country, and there is little of the general uniformity of temperature and other conditions prevailing east of the one hundredth meridian. It is believed that dynamic compression of the air forced down mountain sides and into long narrow valleys plays an important role in determining local climates.

"Foehn" or "Chinook" conditions must be studied from the vantage ground of high level stations. Perhaps the most destructive single condition in California (not excepting a severe frost or an exceptionally severe storm) is the norther of the Great Valley or the kindred wind known as the Santa Ana of the region south of the Sierra Madre. Handicapped as the forecaster is on the Pacific Coast by a paucity of reports from the west, it is all the more necessary to obtain reports in other ways. Mountain winds play no inconsiderable part in the meteorology of the coast. We have the action of the wind in its general easterly drift, the air circulation due to the procession of passing disturbances, and, more pronounced still, the localized wind currents or forced draughts up and down the mountain flanks and through the numerous valleys. It is well known that many stations located in valleys are now of doubtful service to the forecaster because the reports do not indicate true cyclonic wind movements.

It is of course no easy matter to erect, equip, and maintain mountain observatories, and while it might be possible to carry out the plan as outlined, it would probably be much better to place self-recording apparatus on the summits, properly exposed, and establish a series of camps at levels of five, eight, and twelve thousand feet.

ELEVATION OF MT. RAINIER.

Columbia Crest, summit of Mt. Rainier, July 25. 1905, 11 a. m. to 12 noon. Observers J. N. L. and A. G. M. Mercurial barometers Green standard No. 1664 and No. 1554; four readings, 17.614; 17.616, 17.630, 17.632 inches. Temperature, mean, 39° F. Mean pressure, corrected for temperature, instrumental error, and gravity, 17.663 inches. Mean temperature of air column, obtained from readings at summit and at sea level, 50° F.

Sea level reading, mean of Tacoma, Seattle, Portland, and Spokane, 29.960 inches.

$$h - h_o = 56517 + 123.3\,\theta + .003\,h \quad (1 + 0.378\,\frac{e}{B})\ (1 + .0026\cos 2\phi)\log\frac{B_o}{B}$$

which may be written

$$\log 29.960 = \log 17.663 + \frac{h - h_o}{56517 + (123.3 \times 50^\circ) + .003\,h}\,(1 - \beta)\,(1 - \gamma)$$

$h = 62725 \times 0.229478 = 14{,}394$ feet.

The boiling point as determined on the south rim of the crater, probably one hundred feet below the true summit, was 86°.4 C. (187°.4 F.). The equivalent pressure would be 17.960 inches. We shall probably not be greatly in error if we assume that the boiling point on the summit is about 186°.8, and the equivalent pressure 17.73 inches. A sling psychrometer gave the following:

Dry, 37°.0 F.	36°.4	36°.5	36°.5	37°.0	Mean, 36°.7
Wet, 32°.0	28°.0	25°.0	24°.2	25°.5	Mean, 26°.9

The dew point was approximately 10°, vapor tension 0.07 inch and $\frac{e}{B} = .0004$

ELEVATION OF MT. SHASTA.

Summit of Mt. Shasta, August 5, 1905, 12 noon to 1:30 p. m.; six readings, 17.988, 17.990, 17.992, 17.977, 17.962, 17.980 inches. Mean pressure, corrected for temperature, instrumental error, and gravity, 17.993; mean temperature air column, 60° F. Sea level readings, Eureka, San Francisco, 30.000 inches.

$h = 63958 \times 0.222017 = 14{,}200$ feet.

The boiling point at the summit was 86°.5 C. (187°.7 F.). Equivalent pressure, 18.080 inches.

The height of Shasta given on the Geological Survey sheet is 14,380 feet (intended for 14.389 feet); but this elevation was determined more than twenty years ago by combining the results obtained by vertical angles and mercurial barometers. In a letter dated August 24, 1905, the acting director of the survey states that "doubt is thrown on the value from the fact that an exact elevation of the base station was not known, and the methods used would now be considered only approximate."

MISCELLANEOUS OBSERVATIONS

The following table of boiling points may be interesting. It should, however, be noted that a strong wind was blowing when the readings were made at Mt. Rainier on the south rim of the crater.

Whitney, 186°.47 F. (Hallock, 1903).
Rainier, 187°.4 F. (crater readings).
Estimated summit reading, 186°.8
Shasta, 187°.7 F.
Muir's Camp, 194° F.
Estimated height, 10,000 feet.
Paradise Valley, Sierra Camp, 202°.4 F.
Estimated height, 5700 feet.
Horse Camp, Mt. Shasta, 198°.5 F.
Estimated height, 7900 feet.

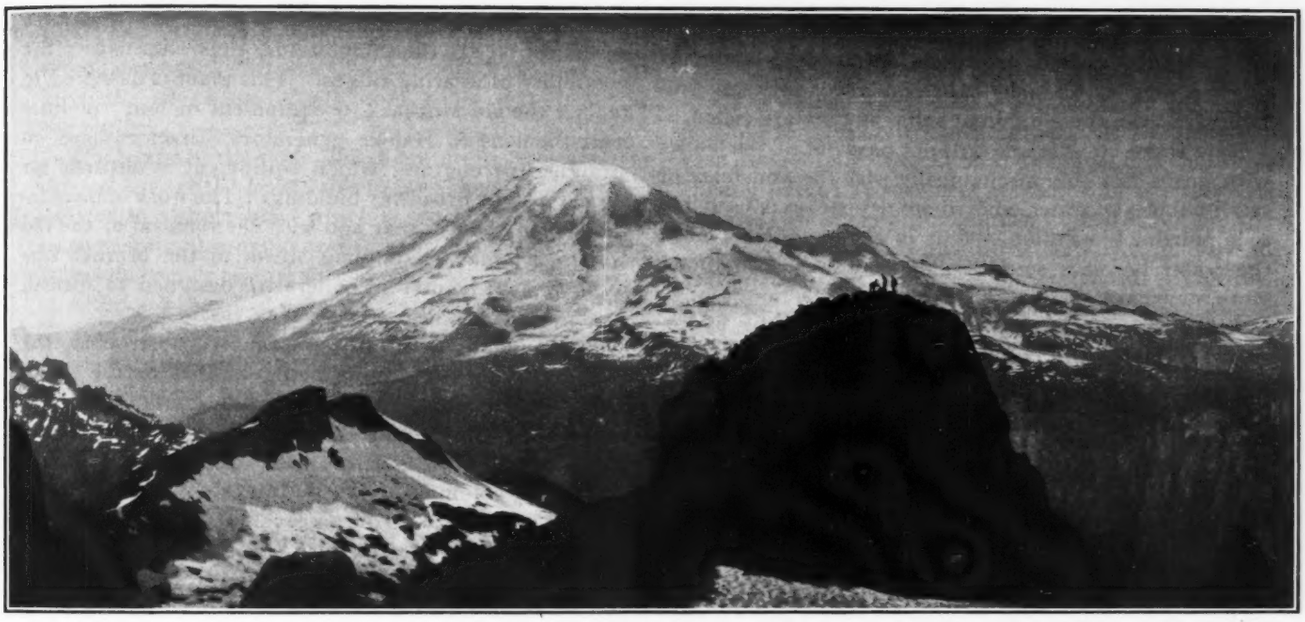
Observations based upon pressure determinations are confessedly less exact than those made by vertical angles or by levels. It is fully recognized in the above determination that the mean temperature of the air column may be in error. If the air were at perfect rest, which it seldom is, a mean value might be obtainable; but on both dates mentioned we observed a marked stratification of the air, and under such conditions temperature and humidity values are indeterminable. Above the level of 10,000 feet the drift of the air appeared to be entirely different from the drift of the lower level. The humidity values, in the opinion of the writer, cannot be properly obtained without a series of simultaneous readings at probably not less than five points in the air column.

HISTORICAL.

The first estimate of the height of Mt. Rainier was made by Captain George Vancouver on Saturday, May 26, 1792. He had named the "round snowy mountain" on Tuesday, May 8th, after his friend, Rear-Admiral Rainier. No one had a better right to stand sponsor. The names which he gave to the peaks, bays, channels, and islands of the North Pacific coast—Hood and Baker, after Lord Hood and Admiral Baker; Puget Sound, after his first mate, Peter Puget; the Straits of Georgia and Queen Charlotte Sound, after king and queen—have all been graciously accepted and remain unquestioned, save one, Mt. Rainier. In the city of Tacoma the mountain is called Mt. Tacoma. Long before the city existed, Vancouver (first white man to see that section) wrote of the country round about: "The forest trees gradually decreased and the perpetual clothing of snow commenced, a horizontal line from north to south along the range of ragged mountains, from whose summit Mt. Rainier rose conspicuously and seemed as much elevated above them as they were above the sea."* At that time of the year the snow line would be approximately seven thousand feet above sea level. Hence Vancouver's estimate of double this height was not a bad one. Moreover Vancouver first gave the co-ordinates of the mountain: latitude 47° 3″ N., and longitude 238° 2″ (— 360°). There is also an excellent sketch of Mt. Rainier made by J. Sykes, May 17, 1792.

The heights of Mt. Rainier commonly given are: E. S. Ingraham, 14,524 feet; George F. Hyde, U. S. Geological Survey, 1896, 14,519 feet; McClure. McAllister, 1897, 14,528 feet.

Not until a line of precise levels shall be run will the true height of this kingly mountain be determined, and it may be pointed out that even then snowfall may modify the figure slightly. Before the top of the mountain was blown off and the crater formed, the summit was probably fifteen hundred feet higher than Columbia Crest.



MT. RAINIER AND THE UNICORN FROM RIDGE

The acting director of the Geological Survey, under date of August 24, 1905, states that the best determination of the height of Mt. Rainier by one of the typographers in 1902 is 14,363 feet above mean sea level. This value was obtained by means of vertical angle foresights taken from triangulation stations thirteen to twenty-nine miles distant from Rainier. The elevations of these stations were well determined from spirit level observations.

Of all the measurements which have been made in connection with the height of Mt. Rainier, the one which possesses the most pathetic interest is that made by Professor Edgar McClure, of the University of Oregon, on July 27, 1897, at 4:30 p. m. A Green standard mercurial barometer, No. 1612, was successfully carried to the summit, and readings carefully made. The reading,

*"A Voyage of Discovery Around the World," six volumes. London, 1801.

corrected for instrumental error and temperature, was 17.708 inches; with an air temperature of 29° F. Returning from the summit Professor McClure lost his life in the act of giving warning to others to avoid the peril of his position. His body and the barometer were subsequently recovered, and the results discussed by his colleague, Professor McAllister. McClure's work in this and other directions was of a high order of accuracy, and probably no one was better fitted to attempt the task which he set for himself. The value obtained, reduced according to present methods, gives an elevation of approximately 14,454 feet. This value is only sixty feet in excess of the value given above, determined by the writer on July 25, 1905, namely, 14,394 feet.

A SYNOPSIS ON BOILER COMPOUNDS.

(CONCLUDED.)

IN this article will be stated some of the *known* reaction of chemistry in plain language.

All of the salts mentioned in the former article, namely, caustic soda, soda ash, bi-carbonate of soda, sulphate of soda, chloride of soda, nitrate of soda, fluorid of soda, etc., are a soda base combined with an acid radical to form these different salts, as they are called.

Soda is not volatile and will not pass out of the boiler with steam, but only mechanically with the wet steam or small bubbles of water, and where dry steam is used the soda remains in solution and it is always soluble until the water becomes so full of it that it can contain no more, or what is known as "saturated."

As stated before, soda will free one-half of the hydrogen to combine with chlorine, from common salt to form hydro-chloric acid, and it will also form a combination with the fluorine of fluorid of soda to form hydro-fluoric acid, and so on in the numerous combinations that will be made. Remember, you cannot take in chemistry without giving or producing energy, and no boiler compound can make the minerals disapper. They will remain in the boiler, and can be got rid of only by way of "blowing off," and all that can be done to prevent scaling is to change their form so that they will not "precipitate" or adhere to the hotter metal surfaces, and remain either in "solution" or "suspension," but will slowly settle down when no more steam is being generated and are readily washed out when the boiler is open, if the parts are cool, but will bake on if enough heat remains or if heat from adjacent boilers is sufficient to drive out the moisture.

Now, we know that a sick man will forget to take the medicine prescribed by his doctor, and will be liable to forget the compound for his boiler, or leave it to the fireman, and thus results are not to be expected.

Look for these conditions: Does the boiler foam or prime; does it rust or oxidize; does it pit and does scale accumulate?

If so, are you following the directions or are you guessing at the amount to be used; and if to be economical with the compound you are spending more in wages to clean boilers by hand power?—*M. P. W.*

THE LARGEST PRIVATE ELECTRIC PLANT.

THERE is at present nearing completion in New York city the largest strictly private electrical plant in the world, says the *Scientific American.* This plant, situated in the basement of the Mutual Life Building, and designed to furnish light and power to the entire city square occupied by the company and its ten ants, consists of four 600 horsepower Watts-Campbell Corliss engines and four 350-kilowatt, 110-volt, generators. The engines and generators are joined by marine couplings, the only strain on which is torsional, the shaft being supported on bearings. Each armature and flywheel also rests on its own shaft, supported between two bearings. This arrangement allows of disassembling any engines or generators without in any way interfering with the other portions of the unit. The engines are of the Tangye or heavy "rolling mill frame" type, supplied with Corliss valve gear. The generators are supplied with a special feature in the form of an automatic brush shifting device which moves the brushes back and forth across the face of the commutator, thus eliminating the possibility of wearing ridges. This plant is designed to replace the old Mutual Life equipment of four 100-kilowatt Siemens & Halske generators, direct coupled to straight line engines, which equipment is destined for the company's Broadway building. The work of installation began about a year ago with the removal of the old boilers, originally supplying steam to the Mutual Life buildings. The present boilers are designed to furnish steam at 300 pounds pressure, if necessary.

The foundations had to be specially constructed, the location of the new units being limited to the space occupied as a court between the various buildings. The difficulty of constructing the foundations was enhanced by the fact that the concrete slabs supporting the structural steel columns of the buildings' framework rested on sand which had to be excavated from between the columns with the greatest care. A sufficient space having been cleared out, beams were laid down to form a closely bolted network, concrete was poured on and about them to fill in the entire excavation, and the various units of the plant were bolted securely to this firmly knit mass. The plant is designed to operate 20,000 incandescent lamps, ten or twelve electric elevators, eight motors of from two to six horsepower, including an electric pump, and six blowers, with fans ranging from thirty-six to sixty inches diameter. Two of the units are now successfully operating, and it is planned to have the other two at work in a short time.

TRAFFIC BEGUN THROUGH SIMPLON TUNNEL.

The first passenger train, carrying notabilities and officials, passed through the Simplon tunnel on January 25, 1906, amid artillery salutes.

Undertaken jointly by the Italian and Swiss governments in 1898, the Simplon tunnel was completed at a cost of more than $15,000,000. It is twelve miles long, extending from Brigue, Switzerland, to Isella, Italy.

GERMAN SUBMARINE CABLES.

A REMARKABLE increase in German shipping, both naval and mercantile, and the general colonial expansion during the last few years, has naturally led both the German Government and commercial community to turn their attention to submarine telegraphy.

To meet these demands, the well known firm of Felten & Guilleaume took in hand the formation of a company for the making and laying of cables, and in 1899 founded the Norddeutsche Seekabelwerke Aktien-Gesellschaft, and established cable works at Nordenham, on the Weser. The location of these works was selected with great care, and proves to be eminently suitable. Nordenham is situated nearly opposite the great port of Bremerhaven, the headquarters of the North German Lloyd Company, the general manager of which is a director of the cable company, and whose good offices are of material assistance in the manning of their ships. Indeed, the company state that partly thanks to this, within twenty-four hours of notice either of their ships can be put into commission and ready for sea. In this respect they certainly have the advantage of all other cable manufacturing companies.

The banks of the river Weser are steep, too, and the deepest draught ships are able to lay alongside the works, moored to a short jetty, which is provided with railway lines and suitable appliances for the handling of heavy stores and other telegraph material.

Although they had been for many years in the habit of making short lengths of submarine cables, the Germans were careful to study the latest English methods, and did not hesitate to engage English specialists and to purchase English machinery and appliances whenever there seemed to be any advantage in so doing.

The two telegraph steamers constructed for this work have each a carrying capacity of 5000 tons. A four-cord cable was laid between Bacton (England) and Borkum (Germany). In 1904 a second Atlantic cable between Germany and America, which work was successfully completed the following year. In 1905 the Shanghai-Yap cable was laid, and during the same year 350 miles of cable between Makassar and Balikpapan.

EDINBURGH'S WATER SUPPLY.

CONSUL FLEMING, of Edinburgh, Scotland, reports the completion of a new reservoir, which increases the water supply of that city by 9,655,000 gallons per day. The construction of this reservoir involved great engineering difficulties, and occupied ten years.

When about fifteen years ago the inadequacy of the water supply of Edinburgh became apparent, it was resolved to construct a large reservoir in the valley of the Tall River, one of the headwaters of the Tweed, thirty-five miles south of Edinburgh, where the gathering ground amounts to 6180 acres, or about ten square miles. Work was begun on this water scheme ten years ago, and it is now completed. The new reservoir has a water surface of 297 acres and a storage capacity of 2,750,000,000 gallons. The embankment thrown across the valley from hill to hill to dam this flood is 1300 feet in length and ninety feet high from the river bed level, having a base of 600 feet in breadth and tapering upward to twenty feet at the top. The high water level in the reservoir is 950 feet above sea level.

It is estimated that this reservoir will add at least 9,655,000 gallons per day to the Edinburgh and district water supply, bringing it up to 25,000,000 gallons per day, equal to fifty-five gallons per head per day to a population of 455,000. The first estimate of the total cost of the Talla water scheme was £750,000 ($3,649,875). The expenditures actually incurred amount to £1,143,290 ($5,563,820.79).

ELECTRICALLY WELDED RAIL JOINTS.

SINCE the introduction about twelve years ago of continuous rails with welded joints for street railway track, says the *Street Railway Journal*, three kinds of welded joints have come into more or less general use in this country and abroad, viz., the Falk, or cast-welded joint; the Lorain, or the joint which is electrically welded by means of current from a transformer, and the Goldschmidt, or thermit-welded joint.

A fourth method is now being employed in Germany, and has been adopted on several railways. It is being exploited by the Accumulatorenfabrik Aktiengesellschaft, of Hagen and Berlin, and it is a modification of the electrically welded joints. It does not depend, however, upon the production of a welding heat by the resistance and transformer method, as in the Lorain system. Instead, a high temperature is secured by the use of a large electric arc, which melts a quantity of steel at the point of application, viz., at the joint. The negative pole of this arc is formed by the rails themselves, and the positive pole is a carbon supplied with direct current from a special generator and other apparatus provided for the purpose. The carbon or positive pole is attached to a holder so that it can be moved back and forth by hand over the pieces of steel, which are to be reduced to a liquefied condition at the joint to form the welding portion. During this process the joint itself is held in a form or mold, so that as the metal melts it flows underneath and around the base and under the head of the rail. A small quantity of steel is first melted, and additional steel is fed into the arc until enough has been melted to form the weld.

The steel employed is of the same composition as that used in the rail itself, and is obtained from old rails. The system has been employed to a considerable extent for joint welding by a number of the electric railway companies in Germany during the last few years, and has also been applied to welding steam engine cylinders, power shears, broken gears and for other industrial purposes.

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EDITORIAL.

HUNTINGTON AND THE STATE.

The report that H. E. Huntington intends to invade the northern part of the State will be received with a great deal of interest by the people of northern California. H. E. Huntington has been the best friend that southern California has ever had or ever will have, and had it not been for his enterprise and courage that part of the State would not be so far advanced as it is today.

Mr. Huntington, after the holdings of the Huntingtons were sold out in the Southern Pacific, went to the southern part of the State and there invested a great deal of his own money, and also Eastern capital, in promoting the best interests of the country around Los Angeles. His first idea was to extend the lines of communication and give the people of Los Angeles the best service at the lowest possible cost. This could be accomplished by developing water power, and by the development of water power Mr. Huntington was able to vastly improve the street car service; and then he went further afield, and brought the different little towns that are scattered to the south, north, east and west of Los Angeles in touch with the center, or the heart, as it were, of the country.

These different schemes required the outlay of large sums of money, and it is probable that even the stout heart of Mr. Huntington quailed at the cost of the work; but he persevered, and success has crowned all his efforts.

It has been the sneer of many that the people in the south are living on climate. This is true to a partial extent, and it is also true that the south depends a great deal upon the rich Eastern tourist; but these allegations are only partially true, as can be learned by an examination into the figures that can be given out both by the Southern Pacific and the Santa Fe roads. These lines have for the past few years put into effect what is known as a colonist rate, and this low rate has attracted to the Coast a vast number of farmers from the middle west. Now we have cheap farming lands in this part of the State, while the south has always held land at high prices. Despite the fact that we are offering cheap acreage to the genuine settlers, men from the East pour into the southern part of the State, and we are fortunate if we can induce a small fraction of this immigration to come north and see the rich lands that we have for sale in the San Joaquin and Sacramento valleys. So desperate has the situation become that the farmers of the San Joaquin Valley have paid men to open real estate offices in the city of Los Angeles and try and induce people to come north.

And why is this?

This is a question that may well be asked. Speaking in a general way the success of the southern part of the State must be attributed to their superior railroad facilities, owing to the large number of electric lines which radiate from the city of Los Angeles. A farmer wants a market for his produce, and he wants as cheap transportation as possible. These electric lines running in every direction appeals to his mind, and when he hears that in the northern part of the State there are few, if any, electric lines, he decides on settling where he is sure of having good and cheap means of transportation.

This is not a chimera born of a mind predisposed in favor of the electric railroad, but it is born out by the facts.

If it is true, and there is every reason to believe it is true, that H. E. Huntington intends to come north and wage an aggressive war upon the Southern Pacific through the paralleling of steam lines by electric roads, and by also connecting towns hitherto without rail communication with an electric system, we shall have a boom in this part of the world which will equal, if not surpass, the boom in the southern part of the State.

It has been suspected by a great many people that the hand of Huntington could be detected in the various electric railroad enterprises that are coming into existence in this section of California. Mr. Huntington is a shrewd business man, and he is also a man keen after the making of dollars, and with the enormous wealth which has to be employed he has no doubt decided that this field is as good as any for the employment of capital.

Another thing has to be considered. The good things in the State are being rapidly taken up by Eastern men. Our timber lands are all practically owned by an Eastern man—D. H. Walker. F. C. Kilpatrick, of New York, has also been picking up several thousand acres, and during his hunt for timber lands he came across a large body of water which he thought would do to water this city. He had no difficulty in engaging the interests of the moneyed men in the East, and the consequence is that in all probability he will be supplying this city with water, and the men who backed him will reap an enormous fortune out of the enterprise.

Mr. Huntington has undoubtedly realized that if he desires to get the measure of good that should come to him out of California he has to be up and doing. It may be safely said that the people of this part of the State will hail with many acclaims the advent of H. E. Huntington in their midst as an electric line builder.

JUDGE MORROW'S DECISION.

Judge Morrow's deeision in the case of the injunction applied for by the Southern Pacific to restrain the Western Pacific from encroaching on its property along the Alameda estuary promises to go down into history as one of the most important rulings that have ever been handed down by a federal judge, and will be used all over the country as a precedent in similar cases.

Apart from the importance of the decision and its far reaching effects, we cannot withhold our meed of praise for the judge. He was certainly put in a trying position. The people of the State have been worked into a fever over the coming into the city of the Gould line, and they have begun to regard the Western Pacific as a sort of deliverer from the bondage of Mr. Harriman. Judge Morrow, judicially, has dealt a severe blow to the aims of the Western Pacific by deciding that they were committing an act of trespass by laying their rails on ground which had been in the possession of the Southern Pacific for a great number of years.

Some hysterically inclined persons have declared that the decision was a blow to all California. No sane person will think for an instant that the failure to obtain a right of way over property already in the possession of another line will prevent the Western Pacific from entering the city The Southern Pacific controls about three hundred acres of the Alameda shore line, and to an outsider it would appear that there was still enough land for the Western Pacific to gain a foothold.

What will possibly be done by the Western Pacific builders is to carry their line south of the training wall, which will not put them to any such disadvantage as some people are inclined to believe.

It is not the wish of THE JOURNAL to take any side in the controversy. It welcomes the Western Pacific to the city as does anybody else who has the good of the community at heart. But THE JOURNAL does think that the Western Pacific has done a great deal to stir up strife and excite the animosity of the people against the Southern Pacific. We, with all sane persons, were beginning to hope that the animus which prevailed against the railroad was dead, and we, with all sane people, cannot help but regret that the steps taken by the Gould builders, whether intentional or not, has been calculated to arouse all those ugly feelings which ought long ago to have been buried.

Resentment has been aroused in the cities of Stockton, Sacramento, San Jose, Oakland and San Francisco.

It is to be presumed that the Southern Pacific is in control of men who have some reasoning powers, and it is idle to say that the Harriman people ever imagined that they could bar the Western Pacific from entering the city. The Western Pacific will undoubtedly be a great factor in the development of the State, and THE JOURNAL fully appreciates the importance of having such men as the Goulds in California, but it repeats that it is a pity that the initial railroad building of this great continental line should have been accompanied with such bitterness.

Naturally the people of the State are ready to take sides and they have assumed the championship of the newcomer.

Will this feeling last? The owners of the Western Pacific should take this into consideration. When the Western Pacific is fully equipped and enters into traffic arrangements with the Southern Pacific, so that there shall be no cutting of rates—what then?

Is not Mr. Harriman using the Gould connection at Ogden for the shipment of oranges East so as to get some revenue out of the Salt Lake road? Will not Mr. Gould and Mr. Harriman, when the Western Pacific is built, be like brothers when it comes to despoiling the Philistines?

THE OTIS ELEVATOR TRUST.

A few weeks ago there was filed in the United States Circuit Court sitting at San Francisco, by United States District Attorney Devlin, acting under the directions of Attorney General Moody, a bill charging that the Otis Elevator Company, with its principal place of business at New York, is an illegal monopoly under the United States anti-trust act, and praying that it may be enjoined from continuing as such.

This bill came as a surprise to the public at large, for it imparts the information that the Otis Elevator Company holds in its grip practically the entire elevator business of the whole country. East of the Rocky Mountains it seems that all competition has been destroyed. The Otis Elevator Company there seems to have throttled and destroyed some of the competing companies and obtained the entire or a controlling interest in all of the rest.

With the Otis Elevator Company about thirty subsidiary companies which the Otis Elevator Company owns, or in which it has acquired controlling interests, are made defendants. This bill is instructive because it shows how the anti-trust act has been defied and how little fear great combinations of wealth have of the United States and her laws. The plan adopted, as shown by this bill, was for the Otis Elevator Company to go into a state and threaten every business in competition with it with suits in equity for alleged infringements of combination patents which it claims to own, and, after holding this threat *in terrorem* over them until they become mellowed, then to propose to take a 51 per cent. interest in them, a proposition generally accepted through sheer inability to refuse and fight.

After getting such a control these subsidiary companies, or rather the minority stockholders in them, were made to pull the Otis Company's chestnuts out of the fire, for thereafter when any kind of opposition appeared the subsidiary companies were made to bid at a loss, and when no opposition appeared the Otis Company bid high and made the subsidiary companies bid higher, so as to insure to it the acceptance of its bid.

In the carrying out of this scheme it makes no difference if the claimed patents of the Otis Company are fakes or that they have not been infringed. Whether its allegations are true or false, the opposition is crushed by the expensive litigation and the result sought by it is attained.

The position of affairs as between the Government on the one side and the illegal trusts on the other is well illustrated by the picture and the story of a man and a boy that we saw and read in the old blue-backed spelling book when we were children. The boy was up a tree belonging to the man and stealing the fruit. The man politely requested him to cease his depredations and to come down. The answer of the boy was to put the thumb of his right hand to his nose and wiggle its fingers at the man. The man then, in order to enforce his request, threw tufts of grass at the defiant little wretch, and when they had no effect pelted him with stones, which brought him into submission and down the tree.

It is now time for the Government to quit throwing tufts of grass and to substitute stones. When injunction suits are brought they are only tufts of grass and the fingers of the trusts are wiggled at the Government; but let the Government commence to throw stones in the shape of sentences to prison against the individuals connected with the trusts, the wiggling of the fingers will cease and their defiance will be gone.

Mr. President, follow up your tufts of grass with stones.

ANOTHER INTERNATIONAL EXPOSITION.

THE following circular letter describes the scope and character of a forthcoming exposition of textiles, electricity, machinery, tools, hardware, etc., to be held in Tourcoing, France, May-September, 1906.

The City of Tourcoing (North of France) is organizing a great International Exposition (May-September, 1906) under the high patronage of the President of the Republic and of the French Government.

The cities of Tourcoing—Roubaix—Lille (Nord Department) are so close to each other that they may be considered as one city of nearly 600,000 inhabitants.

The Nord Department, with its 1,870,000, inhabitants, is the wealthiest in France, paying, as it does, one fourteenth of the total taxation, and having a budget superior to some of the smaller European States.

The district of Tourcoing—Roubaix—Lille is, incontestably, for textiles and some other industries, the most important manufacturing district of France, having a constant need of American products and goods.

The total commerce between the United States and France, as shown by figures compiled by the Bureau of Statistics of the Department of Commerce and Labor, of Washington, amounted, in the fiscal year 1905, to about $166,000,000.

Therefore, as Americans, we should not hesitate to take advantage of this Exhibition in Tourcoing.

The *Daily Consular and Trade Reports*, edited by the Department of Commerce and Labor, of Washington, in a long article concerning the World's Fair of Tourcoing, is saying, namely:

"Tourcoing, an important textile center of continental Europe, is to open an International Exposition on the first of May.

"Inasmuch as England, Belgium and Germany are to be represented, very little urging ought to be needed to get American manufacturers to exhibit. Moreover, the French are going over to electrical machines and appliances in manufactures, harnessing every river in the Republic for manufacturing purposes. This alone is indicative of possibilities for American manufacturers of electrical appliances."

Under the ruling of the French Government exhibits are free from import duties, and special reduced freight rates are allowed on the French railroads and on the French Steamship line.

The awards will be diplomas of grand prize, and of gold, silver and bronze medals.

A MODEL CLUB FOR EMPLOYEES.

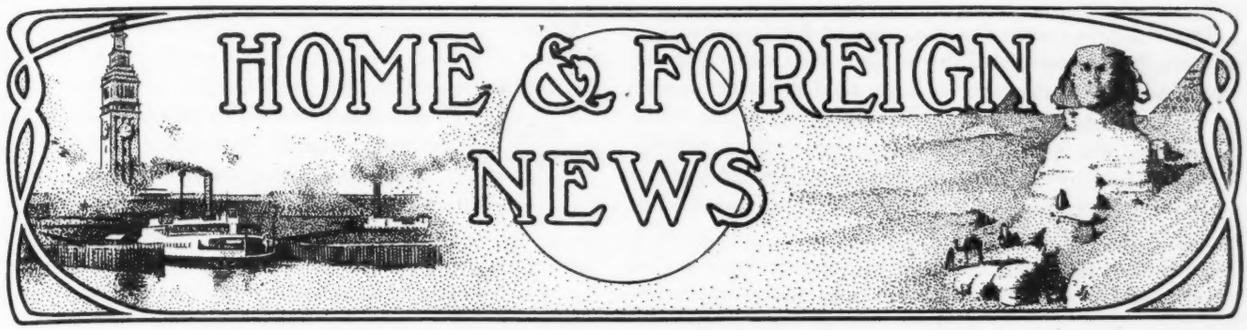
THE Allis-Chalmers Club, of Milwaukee, Wis., has issued an attractive little brochure containing its constitution and by-laws, which are very complete and concise. The printing of these rules is not, in itself, particularly noteworthy; but it calls attention to the class of organizations that are being formed in connection with some of the largest manufacturing and industrial plants of the country, viz: clubs designed to contribute to the comfort, social intercourse and efficiency of employees. The Allis-Chalmers Company has established for its office men, superintendents and foremen a well-appointed club, occupying quarters in a former mansion house near the works, there, for a nominal yearly fee, members are given all the benefits usual to such organizations. During the noon hour a course dinner is served at approximately what the service actually costs, and supper may also be had by those who are obliged to stay late at the office.

As the club building stands in a residence district and is easily accessible from all parts of the city, it is kept open every evening for the benefit of members, who make free use of the periodicals, games, etc., contained in the reading room. Nights are also frequently set apart for general receptions and entertainments given separately by members of either sex, the annual dues being devoted to a fund for such purposes.

The action of the Allis-Chalmers Company in founding and maintaining this club is one which other manufacturers can well afford to emulate, for its effect upon employees and their working efficiency is extremely beneficial. One of the greatest of the advantages to be derived is from bringing men in different departments together, at least once a day, thereby tending to establish more of a feeling of fellowship and consequently closer co-operation between them.

A FLATTERING REPORT.

THE treasurer in closing the affairs of the International Electrical Congress in St. Louis in 1904 reported that the total expenditures of the Congress somewhat exceeded the total amount of the membership fees. When the deficit became known a canvass was instituted for the sale of the copies of the Transactions at $10 per set and as a result there remains an unexpended balance to the credit of the Congress amounting to $2,046.37. The executive committee of the Congress has decided to offer this unexpended balance to the library of the American Institute of Electrical Engineers as a fund in perpetuity commemorating the International Electrical Congress of St. Louis in 1904, the annual proceeds to be applied to the purchase of international electrical literature.



The use of ferrets to string the wires in conduits had been a joke for years with the men in charge of underground construction. In this connection Superintendent Cline of the Bell Telephone Company at Terra Haute, Ind., recently said:

Telegraph Employees who work Without Salary

"As with a good many other simple methods, we refused to try ferrets because it sounded like a good newspaper story and was impractical. But a test has been made and we know it is the best way to put the lead wire through the ducts. A sort of harness is put on the little animal and attached to it is a strong but light fish line. At the next opening of the duct a piece of meat was hung, and the animal tugged away at his cable of fish line to get to meat.

"In Terre Haute we will try another plan. We will turn a rat loose in the duct and let the ferret go after the rodent. At the opening the rat will run into the trap or bag. We could not let the ferrets have the meat for as soon as they get something in their stomach they go on a strike. We shall not let them have the rats until they have done a day's job. The old method of using wooden rods for pushing the wires through the duct took the labor of several men, and a ferret will do all that three men can do."

In a few months, says the *American Gas Light Journal*, extensive additions and improvements at the gas plant of the Denver (Colo) Gas and Electric Company will be completed. A large force of men is employed and the work is being hurried for several reasons. The gas company needs the new manufacturing facilities and the Union Depot Company needs the land on which the Pintsch gas plant now stands. It is impossible to abandon the old plant until the new one is in operation, because the railroads have no other point between the river and the coast where cars can be charged with gas. With the great increase in railroad traffic and consequently in the demand for Pintsch gas, the gas company is taking care to provide for future demands. The new plant will have a capacity for storage one-third greater than the present establishment and the output will be proportionately greater. The gas will be carried to the depot in pipes, so that cars can be charged while they stand in the yards there and as quickly as possible to provide for rushes that require the constant use of equipment of the railroads. Pintsch gas is now shipped from Denver to a number of other cities in the West and the increased demand will be met by the new plant. The gas is shipped in big tank cars. Not only will the company increase its output of Pintsch gas, but other improvements will be made on the ground recently acquired adjacent to the gas plant on Seventh Street. A number of large buildings will be constructed and in this will be gathered the two tar plants of the company. Only the best buildings will be constructed and the finest machinery of all kinds will be installed. In this manner the manufacturing branches of the company's business will be greatly increased and Denver will supply a larger and wider market with coal-tar, pitch, shingle stains, creosote oils, sheep and cattle dip and similar products, many of them very necessary in all construction work. Improvements are being made also in the coal-gas plant of the company. Others will be started within a few weeks, as soon as the ground can be cleared. It is intended that the entire plant shall be in the best of condition before next winter.

New Gas Plant

The municipal telephone business, says the *Electrical Review*, London has neither been good telephony nor good business. The class of telephone work done has been deficient in various respects, and the cheap rates adopted, having been based on preliminary estimates that were greatly exceeded when the work came to be done, have been quite uncommercial. Under such unfavourable conditions, and with an active competition to face, the municipal telephone crusade, which started with such a blare of trumpets, has soon degenerated into a pitful struggle to capture some small share of the rapidly growing telephone business of the various towns and to keep up appearances in the eyes of the public. There has been much tall talk in the Council Chambers and in the lay press, but all semblance of doing a series telephone business has long ago disappeared, and during the past year the various municipal systems have relapsed almost in a state of stagnation. In Glasgow, for example, according to the published statistics, the municipal system gained last year only 597 stations, whereas the National Company's system gained 5725 stations. In most of the towns where there is municipal competition in telephony, the National Company's system is now double, or more than double, the size of the municipal system, and in every case is increasing at a much greater rate.

English Municipal Telephone Business A Failure

Therefore, in every way the municipal telephone competition has been a failure. The few municipalities which have embarked on it have wasted much money by starting a difficult and very technical business without giving the subject the consideration it deserved. Misled at first by optimistic estimates, they afterwards felt bound to maintain the unduly low rates which were the main feature of the municipal telephone propaganda, and have consequently failed to provide for depreciation in sufficient measure to safeguard the capital invested. We have been told repeatedly that no depreciation is necessary in telephone work, especially in municipal telephone work, and that a thirty-year sinking-fund is "excess of caution." It is now evident that those best qualified to judge think quite differently on this important subject of depreciation. Perhaps now that five municipalities have been unable to convince the official telephone authorities of the country that there is no depreciation in telephone plants, those municipalities, and many others, will look a little more careful at the depreciation item in their electric lighting and tramway accounts.

A plan is now underway, says *Electricity*, to connect the Interborough terminus at Flatbush and Atlantic avenues, Brooklyn and Coney Island, New York City, by an electric monorail system.

The New Monorail System Securing Speed of 110 Miles An Hour

The monorail, as its name indicates, consists of a single elevated rail on which the cars are suspended, and among the advantages of this arrangement, the foremost is that the cars cannot be derailed.

This being true it is proposed to run the cars on a two-minute headway, and the length of time to make the trip from the Brooklyn terminus to Coney Island would be cut down to six minutes, a condition much to be desired under the present abominable state of affairs.

The car is so constructed that it can swing freely on the top rail while the guide wheels remain always horizontal, and in fair rolling contact with the guide rails, in such a manner that the friction on the latter on both sides of the truck can be so regulated as not to exceed the friction on the straight line; while the car being in stable equilibrium, by the fact that its center of gravity is below the point of support, assumes the inclination corresponding to the centrifugal force produced in the curves in such a way as to combine the greatest comfort for the passengers with the highest economy in current, while the safety remains absolute.

Each car is to be provided with two motors per truck of 150 horsepower each and during acceleration these will be called upon to develop about double their normal output. On the Coney Island cars, which are eighty, motors of 150 horsepower will be used. These will accelerate the car, weighing about eighty tons fully loaded, so that at the end of two minutes and two miles the full speed of 110 miles per hour will have been attained.

Up near the western border of New York State, says the *San Francisco Call*, an army is being placed in line and is marching eastward toward New York City. It is an army in numbers of steel towers and wooden frames, and they are designed to carry aluminum cables for transmitting electric power from a power house to the water's edge in the gorge on the Canadian side of the river through New York State, to assist in the upbuilding of industry and for the operation of electric railways, the system of which may ultimately extend right across the State from Niagara to New York.

Power From Niagara Falls.

It is a marvelous work, this transmission line of communication, and when it is completed the array of towers and great stretches of cables will be the most wonderful creation of the kind man ever has attempted.

Between Niagara Falls and Lockport the transmission line occupies a private right of way 100 feet wide. From Lockport to Rochester the right of way is 200 feet wide, and from Rochester to Syracuse 100 feet wide, but temporarily the cables between Rochester and Syracuse will extend along the West Shore Railroad on wooden frames made in the shape of the letter A.

From Lockport to Depew, N. Y., there will be a new branch line on a right of way 200 feet wide, so that it is clear the Lockport transformer station will be an important factor in the distribution of Niagara throughout the whole western section of New York.

All told, a total of twelve transformer stations will be built at various points, and unless the Canadians stop the exportation of electricity the line will be in operation within six months.

Elmer A. Burlingame of La Porte, Ind., has invented a device, says the *San Francisco Examiner*, by which he can transmit a message, with or without the use of telegraph wires, from one keyboard, such as that of a linotype machine or a typewriter, to another corresponding set of keys at a distance, and the message will be mechanically received and recorded exactly as transmitted, including capitalization, punctuation and spacing.

Linotpyes or Typewriters to Be Operated by Wireless Electricity.

A human hand is required to start this message on its flight through space, but none is necessary to receive it, for the receiving machine, whether it be a linotype or a typewriter, is controlled as perfectly by the sender as though he were present at its side.

This marvelous invention consists of a simple and inexpensive device with which the sending and receiving machines are equipped for operation by an electrical impulse to be transmitted without wires, or, in other words, by wireless telegraphy.

The cost of installing a complete station for the wireless service, including the masts, electrical appliances and the Burlingame device, need not exceed $2000, to which must be be added the linotype machines (if it be a newspaper office that is being equipped), or otherwise,

whatever style of transmitting or receiving instruments are to be used.

Burlingame's invention needs no Morse code or any other system of signals, for it uses the characters now found on the keyboard of any typewriter or linotype machine, and in this manner it transmits them directly.

Two propositions for cheaper electric light rates have been received by the City of Chicago, one from the Chicago Edison and Commonwealth electric companies and one from City Electrician Carroll on a municipal commercial system furnishing light in the "City Hall district."

Reduce Rates for Chicago

William G. Beale, general counsel for the Edison companies, on February 27th submitted rates for incandescent lighting lower than those which have hitherto prevailed. On behalf of the two companies he offered, in place of the present net charge of 16 cents a kilowatt-hour, a maximum net charge for the next two years of 14 cents and the following three years of 12 cents. Arc street lights are offered at $75 a year instead of $103.

City Electrician Carroll's figures on the proposed municipal system showed that commercial current could be sold in the "City Hall district" for 1.662 cents a kilowatt-hour. After Mr. Corroll had submitted his proposition to the Council committee on gas, oil and electric light the committee asked that Mr. Carroll, with Bion J. Arnold and others, make a more comprehensive statement showing what it would cost for the city to furnish light wherever it is now furnished by the two existing companies.

Why would it not be a good plan, says the *Western Electrician*, for central stations to make more of the "electric lawn-party" idea? In favorable seasons of the year such outdoor evening parties ought to be very popular. One hundred and fifty or two hundred incandescent lamps would make a brave showing in an ordinary lawn. They might be strung in festoons or placed on temporary standards or half concealed in the trees. One "bower" might be arranged for a mercury-vapor light, by which group photographs could be taken by amateurs or professionals. A searchlight would add to the entertainment. The supper might be served al fresco and cooked with electric utensils. Electric fans could be provided if needed. In fact, the electrical installation could be elaborated to any extent to meet the ideas of the host.

Electric Lawn Parties

The central station would provide the whole outfit and make the connections, also supplying one or more suitably dressed attendants to look after the installation and explain the use of the cooking and other apparatus to the guests. The cost would of course vary with the amount of time and apparatus used, but would no doubt be cheerfully met by the giver of the party, for the "function" ought to be a great success. Electrical appliances would be advertised and a new source of income gained for the electric light company.

Wooden poles entirely covered with layers of cement one and one-half to two inches thick have been tried in Switzerland with apparent good results. A brief account of some tests with these poles is given in the *Indian Electrical, Mechanical and Textile News* (Bombay), December. It is said that poles of this kind have been in use for three years, and it is hoped that they will prove to be as durable as well-kept iron poles, over which they have the advantage of cheapness. To prepare the pole it is first surrounded by wire netting supported from the pole by iron brackets. Then the whole of the pole is covered with cement to the thickness desired. These poles have been used in lengths of thirty-nine feet, forty-two and one-half feet and forty-six feet. Before adoption a number of tests were made with a thirty-nine-foot pole. These poles have a diameter of from seven to nine inches at the top and twelve and one-half inches at the base. The pole was embedded in the ground to a depth of five feet three inches, and was subjected to a pull thirty three feet five inches above the ground. The pull was gradually increased until the pole broke, which happened when the strain was 2370 pounds. Throughout the test the deflections were nearly proportional to this strain. When the pull was 1860 pounds the deflection was two feet, eleven inches.

Cement Covered Wood Poles

The New York State commission on gas and electricity has ordered the fixing of the price of gas in Manhattan, New York City, at 80 cents a thousand feet, a reduction of 20 cents. The Consolidated Gas Company and its subsidiary concerns, which are affected, will, it is said, avail itself of the right to appeal to the Appellate Division of the Supreme Court within thirty days. The order of the state commission is to go into effect on May 1st, to remain in force three years from that date. It provides that the gas to be furnished at the reduced price shall be "of twenty-two candle-power and of a purity and pressure now established by law. It was announced that a similar order will be issued forthwith against the Bronx companies, the Central Union and the Northern Union. The commission quoted figures showing that the cost to the Consolidated Gas Company, the largest of the companies operating in Manhattan Borough, of manufacturing and distributing gas for the year ended on March 31, 1905, was 60¾ cents per thousand cubic feet.

80 Cent Gas Rate for New York City

A powerful searchlight that throws its rays seven and one-half miles, so that objects at a distance of six and one-half miles can be plainly seen is being tested in Switzerland. The light is placed at an altitude of 3600 feet and is of 1,000,000 candle power, being run by twenty-four horsepower. The diameter of the projector is 3.28 feet. The light can be handled by wire from a distance of 656 feet from a motor car which is used to transport it.

Long Distance Searchlight

Underground Electric Traction for Buenos Aires

The committee of public works, of the National Chamber of Deputies of the Republic of Argentine, S. A., has under consideration the project presented by the national executive and containing several articles which are as follows:

Article 1. Authority is hereby granted to the municipality of Buenos Aires to concede the construction and exploitation of a network of subterranean railways by electric traction for the service of urban traffic and also the right to grant concession of all new branches which in the future it may be convenient to construct.

Article 2. The concession shall be granted under the following basis: (*a*) The company obligates itself to construct the lines at its own expense and in strict accordance with plans and estimates which shall be approved by the executive and under the conditions stipulated in the contracts. (*b*) The expropriation of lands for stations, workshops, power house, and track shall be made by the company at its own expense and in accordance with said plans. (*c*) The construction company shall undertake the administration and exploitation of the lines of its own account and risk for a term that shall not exceed forty years, at the expiration of which time, the lines with their track, stations, workshops, rolling stock and other materials of exploitation shall become the property of the municipality of Buenos Aires. (*d*) The materials intended for construction and exploitation of the lines shall be imported duty free and the exploitation shall be free from taxation. (*e*) The contracts for the construction and exploitation that the municipality may effect with the company shall be submitted for approbation to the national executive.

Article 3. The lands necessary for the stations, tracks, workshops and power houses are declared to be for public benefit and their expropriation is hereby authorized.

New Electric Railway System for Peru

Within the present year, Lima, Peru, will have a modern electric railway system. This line, which will include thirty miles of single track, is now under construction for the Ferrocarrilles Urbano de Lima Company, which, for several years, has been operating horse cars in Lima. About one-half of the work of electrical equipment will be completed by the first of July and the balance, it is expected, will be in operation before the beginning of the year 1907.

The work of converting the Lima street railway into an electrical system is under the direct supervision of A. W. McLimont, who is engineer for the Peru Company. The railway material and electrical apparatus that are to be used on this road have been purchased from American concerns through the agency of W. R. Grace & Co., of New York City. Nothing but American railway material is to be used in the electrical work.

The Ferrocarrilles Urbano de Lima Company is now building a substation at Lima which will be equipped with three 400-kilowatt rotary converters. Power will be furnished by the Electric Transmission Company whose hydro-electric power plant is located at Chosica, about thirty miles from Lima. The current is to be conducted from the power station to the railway substation at Lima over high potential transmission lines. The General Electric Company will furnish the electrical apparatus for the substation and for the car equipments.

A Greater Los Angeles Planned

The committee on plans for a greater Los Angeles has mapped out a scheme of consolidation of the city and a portion of the country, with a total area of 700 square miles. The plan of city and county consolidation as outlined at present will provide for merging all towns west of San Gabriel River and south of the northern portion of San Fernando Valley, extending to the mountains and the sea, into greater Los Angeles.

The borough system as adopted in greater New York, and which has worked so successfully, will be considered for greater Los Angeles. It is argued that with the borough system in operation the outlying cities can manage their own affairs, as at present, but a great saving in municipal and county expenses will be effected. Over thirty cities and towns will thus be merged and the total population is estimated to be over 400,000.

Extension of Big Gas Plant.

The People's Gas Light and Coke Company of Chicago is to centralize the manufacturing of its gas in a gigantic plant in the southeastern part of Chicago, which, when completed, will be, it is said, the model gas manufacturing plant of the world. The site for the plant comprises 300 acres located between Thirty-first and Thirty-ninth Streets and Fortieth and Forty-sixth Avenues. The plant is to be erected in units of 10,000,000 cubic feet daily capacity. It is estimated that the cost of one unit will approximate $5,000,000, and inasmuch as it is thought probable that the company will commence operations with the building of two units, the initial expense will approximate $10,000,000.

An Electrically Operated Derrick

An instance of the successful use of an electrically operated derrick has been shown in the building of a large Cunarder at the Dalmarnock iron works, Glasgow. As this was one of the largest ships that has ever been constructed and had a great height, it was necessary to arrange for exceptional derricks. Two steel derricks were constructed, each able to lift a load of five tons to a height of 120 feet from the ground level. They had a working radius of twenty-five feet from the centre of the mast. The derricks were equipped with a thirty-five horsepower motor arranged to lift the loads at two speeds—ninety feet and 210 feet per minute, respectively the lower speed being that at which the full load of five tons was raised.

THE OSCILLOGRAPH.

A GREAT deal of interest has been evinced of late in the electrical instrument known as the oscillograph. This device may be most readily compared to the indicator of a steam engine and the photographic reproduction of the wave

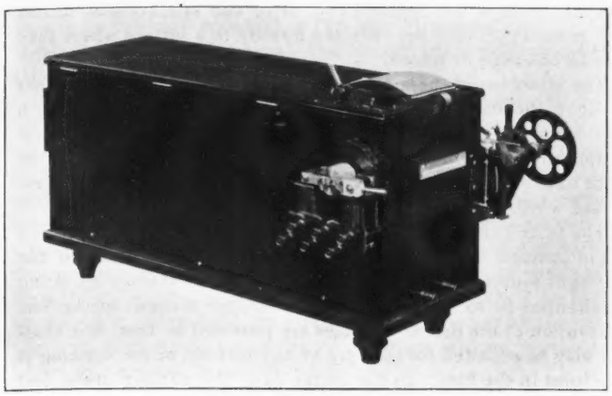


FIGURE 1. GENERAL ELECTRIC OSCILLOGRAPH, SHOWING PHOTOGRAPHIC AND TRACING ATTACHMENTS

form produced by its action (the oscillogram) has its most exact counterpart in the indicator card. Various methods have been devised by different manufacturers to provide a satisfactory method of observing or recording the wave forms of rapidly vary-

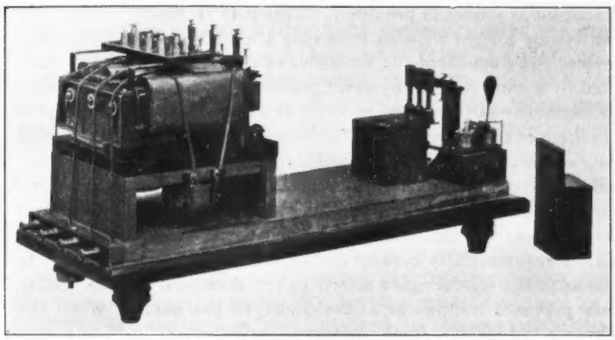


FIGURE 2. INTERNAL ARRANGEMENT OF OSCILLOGRAPH PARTS

ing electric currents and pressures. The oscillograph about to be described, is a most compact form of the vibrating loop tpye, manufactured by the General Electric Company of Schenectady, New York.

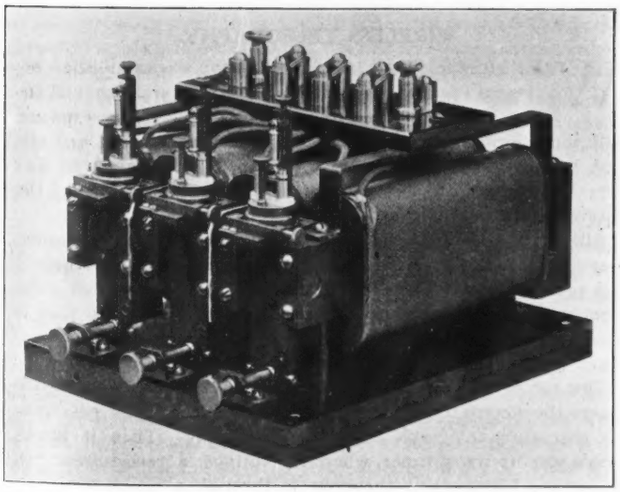


FIGURE 3. THREE ELEMENT OSCILLOGRAPH GALVANOMETER

*We are indebted to the American Society of Electrical Engineers for permission to use Figures 1, 2, 3, 4 and 5.

Both scientific and engineering requirements have been met in this instrument. Among the first are short free periodic time compared to the periodicity of wave forms recorded; critical damping, that is, the free motion just ceases to be oscillatory; neglible self-induction, and sufficient sensibility. Quite as important from an engineering standpoint is the need of an instrument whose working parts are accessible, and of sufficient size that they can be renewed and repaired by persons ordinarily skilled in the handling of testing instruments.

This oscillograph is similar to a D'Arsonval galvonometer in

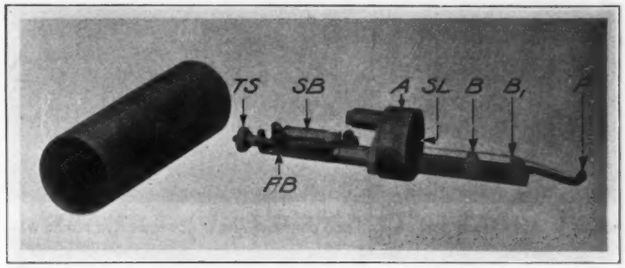


FIGURE 4. OSCILLOGRAPH VIBRATOR AND SHIPPING CASE

T. S. } Thumb screw and spring balance tension adjuster.
S. B. }
B. and B.—Bridges over which vibrator ribbon is stretched.
P.—Pulley.
A.—Terminal block.
SL.—Slot to facilitate assembling.
FB.—Fulcrum block.

that it has a current carrying circuit, located in a powerful magnetic field. The part corresponding to the moving coil in the galvonometer is replaced by two small moving strips which also act as a suspension and carry the mirror. In a light tight box (See Figures 1 and 2) is placed a three-element galvonometer of this design (See Figure 3), combined with devices for viewing or photographically recording current and electromotive force waves. Each galvonometer element, or vibrator, consists of a single loop of very fine ribbon *B* suspended vertically in a powerful magnetic field. The terminals of the galvonometer are the ends of this

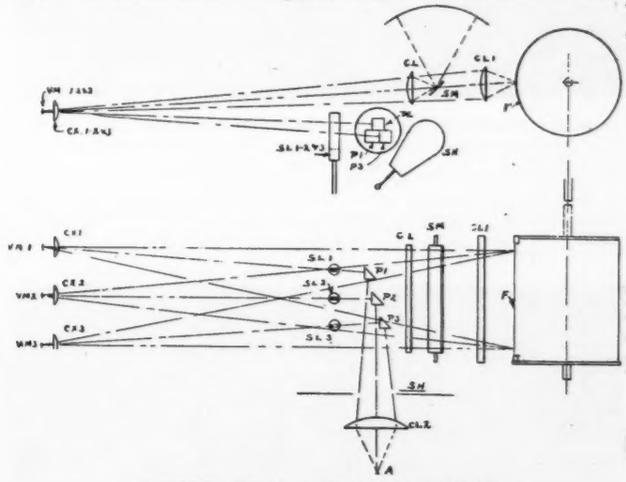


FIGURE 5. OPTICAL SYSTEM OF OSCILLOGRAPH

loop which is held at its lower extremity by an adjustable pulley *P* (See Figure 4).

With the exception of the magnetizing coils, each galvonometer element in the set of three, is entirely complete and can therefore be easily insulated. Each set of vibrating stripe is exposed on all sides when removed from the containing cells, so that any required adjustments or repairs are most conveniently made. Adjustments are further provided so that even if the vibrating mirror is imperfectly attached, it is possible to bring the image of the mirror into the desired place on the photographic film. The containing cell is filled with damping liquid

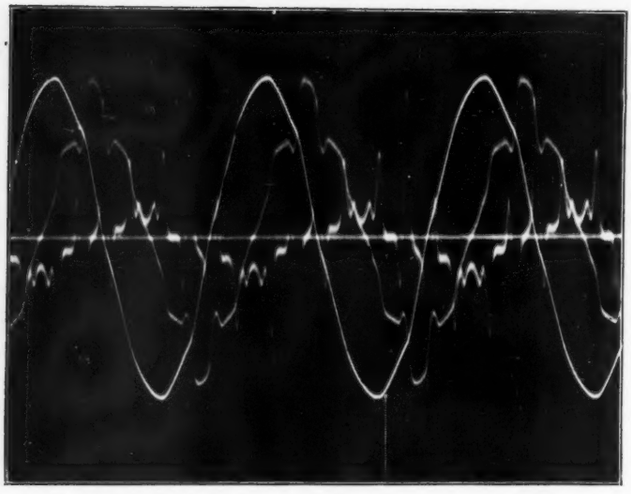


FIGURE 6 INSTANTANEOUSLY RECORDED CURRENT AND ELECTROMOTIVE FORCE WAVES

and the vibrating loop or strips are made of hard drawn silver, with a silvered glass mirror. This latter is usually 80 x 20 x 10 mils;

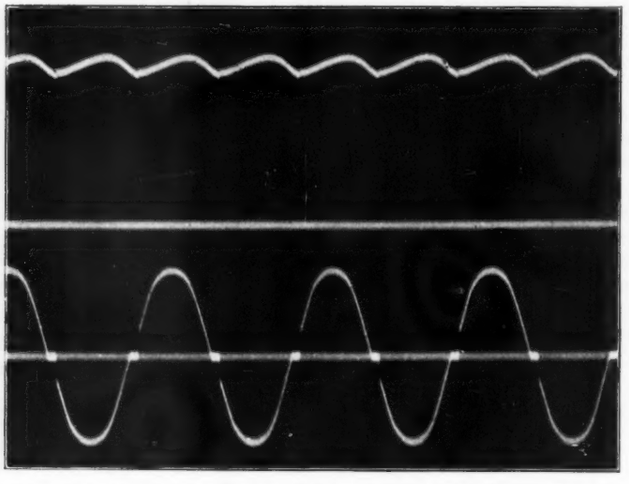


FIGURE 7 CURVES OF GENERAL ELECTRIC MERCURY ARC RECTIFIER. LOWER LINE, ALTERNATING CURRENT SOURCE. UPPER LINE, PULSATING DIRECT CURRENT LOAD

large enough to be easily handled and producing a better photographic record than a smaller mirror. Unless high period is absolutely essential, the manipulatory advantages of the larger size outweigh other considerations.

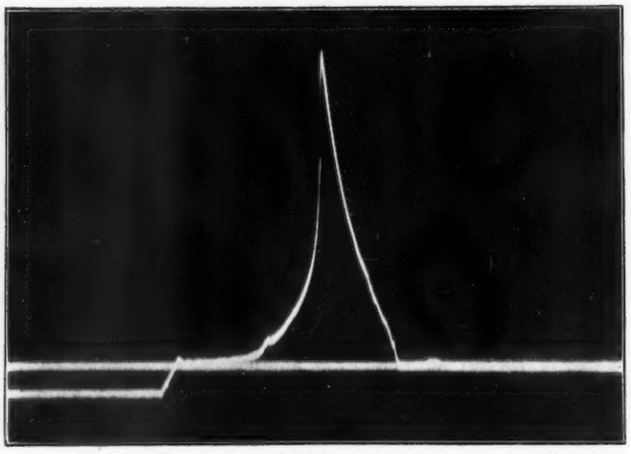


FIGURE 8 OSCILLOGRAM OF INDUCTIVE INCREASE IN VOLTAGE IN FIELD OF SHUNT MOTOR UPON OPENING INSIDE BREAK SWITCH

The optical system is shown in Figure 5. A source of light, usually an arc lamp, is thrown by a lens upon the prisms *P*, 1, 2, 3, and by them to the oscillatory mirrors *VM*, 1, 2, 3. From these mirrors the rays are reflected horizontally to the photographic drum at the opposite end, or to the synchronous mirror *SM* from which they are reflected upward to a surface where they can be observed or traced.

The vibration of these oscillatory mirrors produces three lines of light, the amplitude of their vibration measuring the strength of the current or electromotive force. To produce a wave photographically, a drum carrying a sensitized film is revolved in the path of these light rays thus forming the abscissae of the projected wave.

The same shaft which carries the photographic drum operates a set of contacts which actuates a shutter interposed between the arc-light source and the condensing lens. This shutter-operating mechanism is so arranged that the shutter is open during one revolution of the drum. Devices are provided so that this shutter may be adjusted for opening at any instant, or for opening at the joint in the film. In the latter case, the shutter opens just after passing the joint in the film and closes just before reaching it. This mechanism is used when the time of the occurrence of the phenomena under consideration can be governed. When this cannot be controlled by the operator, the shutter is arranged to open at any instant and close after one complete revolution without regard to the joint in the film.

For viewing recurring waves, as has been stated, a so-called synchronous mirror is provided. This may be easily swung into position by a lever without removing the photographic recording device. The synchronous vibration of this mirror, which is oscillated by a cam driven by synchronous electric motor, provides the necessary range of action along the axis of abscissae and thus an image of the wave form. The vibration of the mirrors having been adjusted so as to have a suitable angle during one complete cycle, the point of light on the screen will move through a path similar to that obtained when the wave is plotted to rectilinear co-ordinates. As the mirror returns to its original position a shutter automatically cuts off the light and does not allow it to pass until the mirror again moves in the direction first indicated. This prevents admission of the light to the surface when the mirror is not moving in the proper direction.

Such an apparatus is useful in studying the action of the various phenomena in electric circuits having not more than 5000 or 6000 complete vibrations per second. The accompaying oscillograms show the application of the General Electric oscillograph to various phases of engineering in which this method of ascertaining hidden electrical conditions has been found highly valuable.

WIRELESS TELEGRAPHY.

WIRELESS telegraphic communication was established between Los Angeles and San Diego on March 7th, and the stations where these messages were received were opened with much formality. A number of guests were present and the first messages were from the mayors of San Diego and Los Angeles congratulating each other upon the establishing of the wireless stations.

Although it requires about 20,000 volts of electricity to project messages into the ether, this amount of electricity is not required as a primary asset. The Los Angeles station receives 108 volts from the Pacific Light and Power Company's wires and this is increased to the required voltage by a set of instruments. Messages are sent in the following manner:

The 108 volts of electricity first are carried into a coke-coil where the electricity is "tamed" in order that it may pass into the regulation telegraph key used in sending. Then it passes into a step-up transformer, where the voltage is raised from 108 to 20,000. The current then passes through a set of eighteen Leyden jars which condense the current so that when it reaches the helix sparker it has attained its highest power. It is here

that the transmitting key comes into play, for the sparker is manuipulated so as to "buzz" off the message by breaking the current into dots and dashes, as the code requires.

An oscillating coil determines the wave lengths by means of a ribbon from the Leyden jars. The current with the message then passes into the wire leading to the aerial spark gap, which allows the current to enter two antenna leads which carry it to the apparatus on the high pole and at the same time indicates by the regularity of the spark whether the instrument is sending out the right wave lengths.

Projecting from the head of a "grasshopper" are two "feelers" which point at an angle of about forty-five degrees. They are called the antenna, and it is from the similarity of these feelers that the two wires leading from the transmitting apparatus of the station house to the "cages" on the high pole are also named antenna. These wires are composed of seven small strands of twisted wire which lead to the "cage" a sort of cylindrical arrangement to hold a number of wires. Five parallel wire hoops form the cylinder over which eight wires are stretched to make up the cage, the ends of the wires tapering to cones off the outer hoops so as to connect with the single wires leading to the top of the pole and to the station house.

There are two of these cages, each fifty feet long, thus giving 800 feet of wire from which the wave lengths can project into space and thus meet similar cages at the receiving stations. These cages are used both for transmission and receiving. Twisted strands prove better conductors with less resistance than a single wire of the same diameter.

No electric currents are necessary to receive messages, but small independent cells are used in the receiver to strengthen the magnetic ether waves after their journey. After the messages are caught by the cages, suspended from the high pole, they pass through the antenna switch, at which point the connections are made with the transmitttng apparatus, when sending or cut off to lead direct from the cages to the receiving instruments. The ether waves then pass into a three-coil tuner, an instrument which must be so set as to receive the proper lengths of waves, as attuned with the transmitting instrument an the other station.

From the tuner the magnetic ether waves pass into the electrolectic responder, commonly called the receiver, where they are reinforced by the small dry battery mentioned and sent direct to the telephone receiver clasped to the operator's ears. The latter hears the message in the form of buzzes, instead of the magnetic ticks as usual to the wire telegraph instrument. The message is readily understood by an expert in the Morse code.

The sending of aerograms may best be described by the simple use of a stone and a pool of water. When the stone is dropped into the water waves radiate from the spot where the missile strikes, growing smaller as the diameter increases. The same principle applies to ether waves. When an electric shock strikes the ether the latter is agitated and the waves extend in all directions. These ether waves travel at the rate of 168,000 miles a second, and messages carried by them are conducted in a manner similar to light transmission, except that they are invisible.

Doubtless ether waves are in constant agitation through space and matter, but there is no order to their coming or going. To produce ether waves that can be controlled in the making and receiving has been the task of the experimenters in wireless telegraphy. Several systems are extant in Europe and America, and for years scientists have worked at the problem of harnessing the ether and making it do their bidding in a practicable way.

All depends on the length of ether waves agitated by the sending apparatus, for it is thus that the characters of the Morse code are sent through space. The same principle applies to the wire system, but in that case it is the waves of electricity, or it is so thought to be, for the relation of electricity and ether has not yet been determined, but they are closely allied in wireless work.

It is not so much the actual length of the ether waves as the relative length which allows the characters to be distinguished. In fact there are almost a limitless number of sets of wave lengths that can be used, and this fact makes it impossible to exchange messages unless the instruments at either end are attuned to each other; that is, the receiving instrument must be prepared to accept the same wave lengths as the transmitter sends out, and this is made possible by a very clever instrument called the "tuner," used in receiving, which can be so set as to be in harmony with any set of wave lengths sent out. Because of this requirement it is impossible for messages to be stolen easily, for the operators can change their instruments at a moment's notice, throwing the "ether tappers" out of gear.

The apparatus connected with the sending of wireless messages necessarily is more complicated than that used in sending the ordinary wire messages. Tremendous energy is necessary to agitate the ether sufficiently to affect the instruments receiving the message. Twenty thousand volts of electricity are forced into the transmitting wires through and from which the ether waves radiate into space and matter. The greater the distance a message is sent, the greater must be the power of the electricity.

Stations are equipped with apparatus ranging from two kilowatts in power to fifty kilowatts. Because of the small need of sending messages a great distance from Los Angeles, the local station contains apparatus of but two-kilowatt power, corresponding to about 1½ horsepower. This is sufficient to send messages from 400 to 900 miles ordinarily, and sometimes to greater distances if conditions, not now understood, are favorable.

METER EDUCATION IN BOSTON.*

THE Edison Electric Illuminating Company, of Boston, is leaving no stone unturned to educate the public in the advantages of electricity, and in this connection the meter question was recently brought forward for discussion.

The company pointed out that the latest types of meters are installed in its work, and that every possible care is taken that they shall be accurate. Meters are carefully adjusted for correct registration before they leave the laboratory of the company, and after installation they are again checked with portable standards to guard against any possible derangement during transportation. These early tests are followed by others varying from periods of three to twelve months, according to circumstances. The standards used are checked with absolute standards derived from the National Bureau of Standards at Washington.

In actual service a meter is not considered correct unless it registers within 2 per cent. of absolute accuracy, although the law permits a meter to be esteemed correct even though it may vary 5 per cent. either fast or slow. All meters are subject to test by the Massachusetts Board of Gas and Electric Light Commissioners in case of appeal by the customers. Should it be found, when such test is made, that the meter is in error as against the customer, then the cost of making the test is charged to the company. The company, however, has actually been called upon to pay for but one such test.—*Howard S. Knowlton, Newton, Mass.*

AN ELECTRIC SKATE.

A novel device in the way of an automobile skate driven by a small gasoline motor is the invention of M. Constantini, a well known constructor of Paris. The new skate consists of a foot-plate which is mounted upon four rubber-tired wheels, while the motor occupies the middle space. Thus the apparatus can be adapted to the foot just as the ordinary roller-skate, the only difference being that the wheels are of a considerably larger diameter. The little device is found to work very well and a person soon learns how to run it. There is no doubt that it will offer a new means of recreation to lovers of sport. It has already attracted considerable attention in Paris, where it has but lately made its appearance.

PERSONAL

Dr. W. E. Winship, sales engineer Gould storage battery, is making a business trip to the Coast in the interest of the company.

Mr. J. J. Gorman, formerly president of the Manhattan Electrical Supply Company, but recently retired from active management owing to ill health, spent the month of February in Los Angeles and vicinity, and passed through San Francisco on his way to Portland. Mr. Gorman will return to New York in about thirty days, and if health permits, we trust he will be able to resume his former duties.

Mr. Rudolph Warner Van Norden, formerly superintendent of the Central California Electric Company until its absorption by the California Gas and Electric Company, has opened offices in the Rialto Building, San Francisco. Mr. Van Norden will follow his profession of supervising and constructing engineer and has already been engaged to take charge of several important engineering projects.

Mr. E. Ward Wilkins, secretary and manager of Patrick, Carter & Wilkins Co., of Philadelphia, will arrive in San Francisco about April 1st, and make his headquarters during his visit at the office of the Electric Appliance Company. Patrick, Carter & Wilkins Co's line of annunciators, bells etc., are well known on the Pacific Coast and we are certain that the electrical fraternity will do all that is possible to make Mr. Wilkin's stay with us an enjoyable one.

Mr. Arthur Giesler, who as cheif engineer and designer of hydaulic installation for the Platt Iron Works Company of Dayton, O., has been responsible for the recent successes of that company and the man to whom in this country credit is due for modern water wheel practice, more than to any other individual, has established himself in New York, with offices at 170 Broadway, as a consulting engineer, and will devote himself to the speciality of hydro-turbine power plants and hydro-turbine pumping stations.

Mr. Bruce Cornwall, president of the Occidental Machinery Company, San Francisco, is now away from his office on a two month's trip East; he expects to visit the eastern houses represented by the Occidental Machinery Company and to perfect arrangements now pending with several other large concerns for handling their Pacific Coast interests. Mr. Cornwall, besides being a good buisness man, has a charming personality and THE JOURNAL is confident that he will attract to himself a host of Eastern friends equal to the wide circle he has on the Pacific Coast and the Northwest.

Mr. W. D. Packard, of the New York and Ohio Company, manufacturers of incandescent lamps and transformers, have been paying a visit to San Francisco in the interest of the company he represents. Mr. Packard has left for Los Angeles, where he will spend several days before returning to the factory. He reports an enormous increase in trade and in the sale of their famous Packard lamps and transformers.

OBITUARY.

Samuel J. Hendy, president of the Joshua Hendy Machine Works of San Francisco, died at his home on March 14th after a short illness. Mr. Hendy was a nephew of one of the pioneer machinery men on the Coast. He had grown up from boyhood in the business of which he finally became the head. He was a public spirited man and identified with several fraternal organizations. For many years he was treasurer of the California Miners' Association. His attractive personality and his geniality won him a host of friends. His brother, John Hendy, has been elected his successor as president of the Joshua Hendy Machine Works.

Multipolar Motors—The Allis-Chalmers Company has in its bulletin No. 1046 given much valuable information regarding Bullock multipolar motors and generators, types H and H I which will be valuable to the trade.

Steam Pumps—The National Steam Pump Company, of Upper Sandusky, O., has published a little volume which will be eminently useful to engineers. This booklet gives concise and reliable information regarding steam pumping machinery and it further contains much useful information for the convenience of engineers in making calculations. The compendium at the end of the book will be found interesting to others than engineers. These tables are valuable, and at a glance a man who wanted to know the pressure of water in pounds per square-inch could find what he is seeking by referring to the tabulated statements. The company is to be congratulated on the excellence of its publication.

Railway Generators—The Allis-Chalmers Company have in their bulletin 1049 given an exhaustive treatise on railway generators which will be found useful to all who have to deal with this machinery.

Lighting Scientifically Considered—A careful perusal of two booklets issued by the Holophane Glass Company, of New York, will be found interesting by even those who take a perfunctory interest in the matter of lighting. It is not till one has read these little books that it is realized how important is the question of proper lighting. In these books we are told the best lighting methods for churches, schools and libraries. A great deal of science is brought to bear upon the illumination of a church and the lighting of a church of the cathedrial type is entirely distinct from that of the amphitheater type. The booklet will tell what is the best reflector to be used. It is the same with libraries, theaters and hospitals and a study of this admirable booklet will be profitable to those interested in these buildings.

Interesting Bulletins—Bulletin No. 4435 of the General Electric Company gives much information on the isolated plant switchboard panels with circuit breakers, and its bulletin 4432 deals with prepayment attachment for Thompson recording wattmeters and high torque induction wattmeters. Bulletin 4433 is on rotary converters for railway service.

Carriage Feed—Bulletin No 1702 of the Allis-Chalmers Company deals with the subject of Carriage Feed. The pamphlet is well illustrated and will be found valuable by the expert.

Science Abstracts—THE JOURNAL is in receipt of two pamphlets entitled "*Science Abstracts*," published by Spon & Chamberlain, of New York. Section A deals on physics and section B on electrical engineering. These small pamphlets will be found of immense value to the engineer who has to deal with electric machinery. The information that is embodied within their covers is secured from the best available sources.

Type N. L.—The National Electric Company in its bulletin No. 367 has printed much valuable information of Type N. L. direct current motors and generators. The bulletin is well illustrated.

Treatise on Coal—The United Coke and Gas Company, of New York, are the publishers of a volume which would be a credit to any house in the world. There are few volumes more beautifully printed, more clearly illustrated and with better text than the one entitled "A Short Treatise on the Destructive Distillation of Bituminous Coal, with Reference to the United Otto System of By-product Coke Ovens." The book is printed on heavy paper, in fine bold type and a casual glance at the table of contents will give a comprehensive idea of the scope of the work. In the opening chapter is a short treatise on coal which can be read with interest by anybody, and there are such delicate illustrations in the pages that the volume would not look out of place on any drawing room table. The book is bound in fine red morocco and its outward appearance is as good as its contents are valuable.

Bossert's Pamphlet—The Bossert Electric Construction Company has issued a neat little pamphlet containing a list of the articles manufactured by them which is well illustrated.

Current Motors—The Allis-Chalmers Company has printed in book form a good deal of valuable information relative to the installation and operation of Bullock direct current motors and generators. In this little pamphlet much information can be gleaned about the running and control of these motors.

Turbines and Pumps—The T. P. Morris Company in its bulletin No. 2 has published a technical paper for the use of consulting hydraulic engineers and others desiring information concerning the variation in power and efficiency of a turbine wheel when running at a constant number of revolutions and operating under varying head of water. The information in this pamphlet will be found useful to those contemplating the utilization and development of water power and especially to those making a study of the economic running of water wheels.

Fan Motors—The Westinghouse Company has published an interesting little pamphlet on fan motors which is profusely illustrated. It shows what comfort can be obtained at little cost by fan motors.

Koerting Engine—The Koerting two-cycle double acting gas engine is claimed by its builders to be the only engine of large capacity which can operate successfully on blast furnace, natural and producer gas.

Electricity in Shipyards—The Allis-Chalmers Company in its bulletin 1039 gives an interesting description of the Fore River Ship and Engine Company at Quincy, Mass., which covers seventy-eight acres of land lying along the Weymouth Fore River upon the grounds which have a frontage of one and three-quarter miles. Upon this area there are fourteen large buildings and a considerable number of smaller ones, enclosing a floor area of nearly eleven acres, and comprising all of the multitudinous industries which are necessary in the construction of modern vessels, both ships of war and of the merchant class. Outside of the unusual completeness of its plant, the most interesting feature of this yard is the fact that electrical power distribution is used throughout, power being generated in a central station, and that every tool used, with the exception of pneumatic ship tools, steam hammers and a few hydraulic presses, is electrically operated.

Single Phase Motors—The Wagner Electric Manufacturing Company, of St. Louis, has in its bulletin No. 75 given a description of the patents which it has recently procured. In the past year the company made a number of important improvements in single phase alternating current power motors and the most important of these was the successful development and introduction of a line of single phase motors for elevator service. Another important advancement was the introduction of a limited number of sizes of single phase motors for variable speed work such as driving of ventilating fans and small printing presses.

BOOK REVIEW.

Electric Railway Accounting—W. B. Brockway has published through the McGraw Publishing Company of New York a small book which is entitled "Electrical Railway Accounting." $1.25. This volume will be found interesting to auditors not only of electric lines but all railroads. Mr. Brockway is the general auditor of the Nashville (Tenn.) Railway and Light Company and also ex-secretary of the Street Railway Accountants Association of America. He is therefore, well qualified to speak upon the subject.

Irrigation in California—F. E. Trask, of the American Society of Civil Engineers, has, in an able speech which was delivered before that association given his ideas as to the irrigation system of Ontario, Cal., and its development and cost. The speech, which was delivered about one year, ago has been reprinted by the Abner Doble Company.

Alte nating Current—The D Van Nostrand Company have published a book under the title of "Alternating Currents" ($2.00) which will be found most useful to those interested in electrical work. It is written by Alfred Hay, DSc., M. T. E. E., and in the following pages an attempt is made to furnish the reader with a general account of the principles, construction, and use of alternate current measuring instruments, generators, motors and transforming machinery. Special attention is devoted to methods of testing. The first three chapters contain a sketch of alternate current theory. The author has tried, as far as possible, to exclude everything of purely academic or historical interest; on the other hand, he has not hesitated to devote a good deal of space to matters which are either not generally understood, or which are of too recent origin to have found their way into many text-books.

The author desires to express his indebtedness to the various firms who supplied him with working drawings and placed other information at his disposal; especially would he like to mention in this connection The Electric Construction Company, Ltd.; Messrs. Everett, Edgcumbe and Company; Messrs. Kelvin and James White, Ltd.; and Messrs. Nalder Bros. and Thompson, Ltd.

The bulk of the illustrations have been specially prepared for this book.

The Sibley Journal—Cornell University has a remarkably good monthly which it publishes under the caption of *The Sibley Journal of Engineering* The magazine is devoted to engineering and the subjects are handled in a masterly fashion.

Wisconsin Water Supply—The bulletin of the University of Wisconsin just issued regarding the sources of water supply in Wisconsin is interesting. The pamphlet is accompanied by several maps which show the topography of the State. The sources of water supply is divided into two main groups, namely, surface waters and ground waters, and the author of the brochure, W. G. Kirchoffer has gone deeply into the subject, showing an intimate knowledge of the conditions of the State.

Yale Scientific Monthly—The senior class of the Sheffield Scientific School, Yale University, has issued an eminently interesting monthly for the past month. The monthly is also well illustrated and the writers of the various articles show familiarity with the subjects about which they write.

Electric Power Transmission—A practical treatise for practical men, by Louis Bell, Ph. D. Fourth edition, revised and enlarged; 721 pages; McGraw Publishing Company, New York; price $4.00 net. This book is so well known from earlier editions as to require little comment. Its revision brings it abreast with the times again.

Practical Electric Railway Hand Book, by Albert B. Herrick, Second edition, revised and corrected; 460 pages; McGraw Publishing Company, New York; price $3.00 net. In this second edition a number of sections have been re-written and expanded

and new subjects have been introduced to accord with recent developments in electric transportation. New methods of testing have been described and data on new types of apparatus have been added.

Standard Telephone Wiring for Common Battery and Magneto Systems—Illustrated, by James F. Fairman; ninety-one pages; McGraw Publishing Company, New York; price $1.00 net. A handbook for telephone men containing diagrams of circuits for straight lines, party lines, plans, substations, private lines and intercommunicating systems, with brief descriptions of the apparatus used, and rules of the fire underwriters. Bound in semi-flexible covers. The diagrams show methods of connecting various types of apparatus. A good book for anyone having any connection with operation and maintenance of telephone apparatus.

The Wiring Handbook, with Complete Labor-Saving Tables and Digest of Underwriters Rules, by Cecil P. Poole; eighty-five pages; McGraw Publishing Company, 114 Liberty Street, New York; price $1.00 net. An excellent book. It contains in condensed form practically all the information required for laying out inside work, without irrelevant material that is found in most books of this type. It gives in addition to usual wiring diagrams and tables, diagrams for connections of motors and meters of various types. It is bound in semi-flexible covers, and is of convenient size to be carried in the pocket. It is recommended to wiremen, engineers and architects.

Record of Electrical Congress—"The Transactions of the International Electric Congress, St. Louis, 1904," is the title of a handsomely bound and well illustrated volume which has been received by THE JOURNAL. It goes without saying that the convention which was held in St. Louis was remarkable in more ways than one. The cleverest men in the electrical world attended and exchanged views and read papers upon topics connected with their profession. Men from Europe vied with men from America and each gave forth from their store to add to the general knowledge. The transactions of this Congress were carefully recorded by an able corps of secretaries and the result is Volume III. The book was printed under the care of the general secretary and treasurer and may well be called a work of love. A brief glance at the table of contents will show the range of the book. There is an able paper by Philip Dawson on "The Electrification of British Railways, Theory of the Single-phase Motor by Dr. C. P. Steinmetz," "The Booster Machine in Railway Service and Its Most Suitable Control by Prof. Dr. Gustav Rasch. These are some of the papers that have been taken from the table and will suffice to give some idea of the range of subjects treated.

The Business of Contracting—The Technical Book Agency has published in book form a series of articles which have appeared in *The Contractor*, relating to "The Business of Contracting." All persons who take or make contracts will find this book vastly interesting.

The Management of Accumulators—A practical handbook, by Sir David Salomons, ninth edition revised, illustrated; 178 pages. D. Van Nostrand & Co., New York; price $2.50 net. A revision as a separate book of volume I, of the previous edition, which consisted of three volumes, entitled "Electric Light Installations and the Management of Accumulators." While the types of accumulators described are those in use in England, the general text on testing and handling of the apparatus makes it of value to operators having charge of other types. The descriptions are simple and the book is one from which both operator and engineer may get valuable information.

The Pittsburgh Plate Glass Company, whose complete power and electrical equipment for the new plant at Crystal City, Mo., was purchased from the Allis-Chalmers Company, has recently ordered two additional generators for the same plant.

POWER LINE WILL BE 100 MILES LONG.*

THE fire to the Butte reduction works, of Senator W. A. Clark, will take the product of the Clark mines to the Washoe smelter, at Anaconda. By a peculiar coincidence, that property was just enlarging its plant, and contracts had been let by the Washoe Company for four of the largest induction motors ever installed in the West. By July 15th, the mammoth 10,000-ton concentrator of the Washoe smelter, at Anaconda, will be running with power supplied by the two plants of the Helena Power Transmission Company, on the Missouri River near Helena, nearly 100 miles from Anaconda. Each of the big motors will weigh over forty tons. The weight of the entire equipment, when ready for shipment from the Allis-Chalmers Company, of Milwaukee, will be approximately 258 tons. The motors to be installed are said to be the largest in the world, with the exception of those at Niagara Falls.

The placing of the order for this gigantic electrical equipment marks the beginning of the completion of improvements involving about $750,000. In addition to supplying power for the smelter and street-railway at Anaconda, the improvements now under way, when complete, will make it possible for the mines of Butte to utilize Missouri River power.

A second huge dam is being built across the Missouri River, near Helena. The waters will be backed up by the dam and form a lake near the capital city. The waters of the lake will approach within eight miles of the city proper, whereas they are now more than twelve miles distant. The transmission of 70,000 volts of electricity to Anaconda, nearly 100 miles away, will involve a pole line and accessory equipment which will be one of the electrical wonders of the West.—*Seattle Telegram.*

THE AUTOMATIC REFRIGERATING COMPANY MOVES.

IT is rumored that the Automatic Refrigerating Company of 22 Thomas Street, New York, represents the merged interests of the Automatic Refrigerating Company, of Cleveland, O., the Singer Automatic Ice Machine Company, of Bridgeport, Conn., the Marshall Ice and Refrigerating Machine Company, of Boston, Mass., and is about to remove their offices, shop and refrigerating show plant to Hartford, Conn., where provision has been made for greatly increased manufacturing facilities.

The Automatic Company occupies a rather unique position in the refrigerating field in that it makes a specialty of small equipment for which most of the two hundred manufacturers of refrigerating and ice-making machines do not care to bid. The three companies named were among the first to take up the manufacture and sale of small automatically controlled systems, but each realized that its field of usefulness was greatly circumscribed by the patents held by the two remaining companies. To the end of removing this barrier to the development of automatic refrigeration the three companies combined and now control all the patents essential to the development of an ideal automatic system.

The famous case of the State of Missouri vs, the State of Illinois involving the right of the city of Chicago to divert its sewage into the Mississippi River through the Chicago sanitary canal and the Illinois River has just been decided by the Supreme Court of the United States in favor of Illinois. This decision leaves the way clear for the power development project which is well in hand for using the 40,000 horsepower in water power at Lockport, Ill., the lower end of the sanitary and ship canal. At this point will be installed four 4000 kilo-volt ampere, three-phase, sixty-cycle, 6600-volt alternating current generators now under constrution in the shops of the Crocker-Wheeler Company, Ampere, N. J.

John C. Cummings, Paris, Ill., has recently concluded the purchase of a twenty inches by thirty-six inches Reynolds Reliance Corliss engines from the Allis-Chalmers Company, builders, Milwaukee, Wis.

INDUSTRIAL

STEEL CASTINGS.

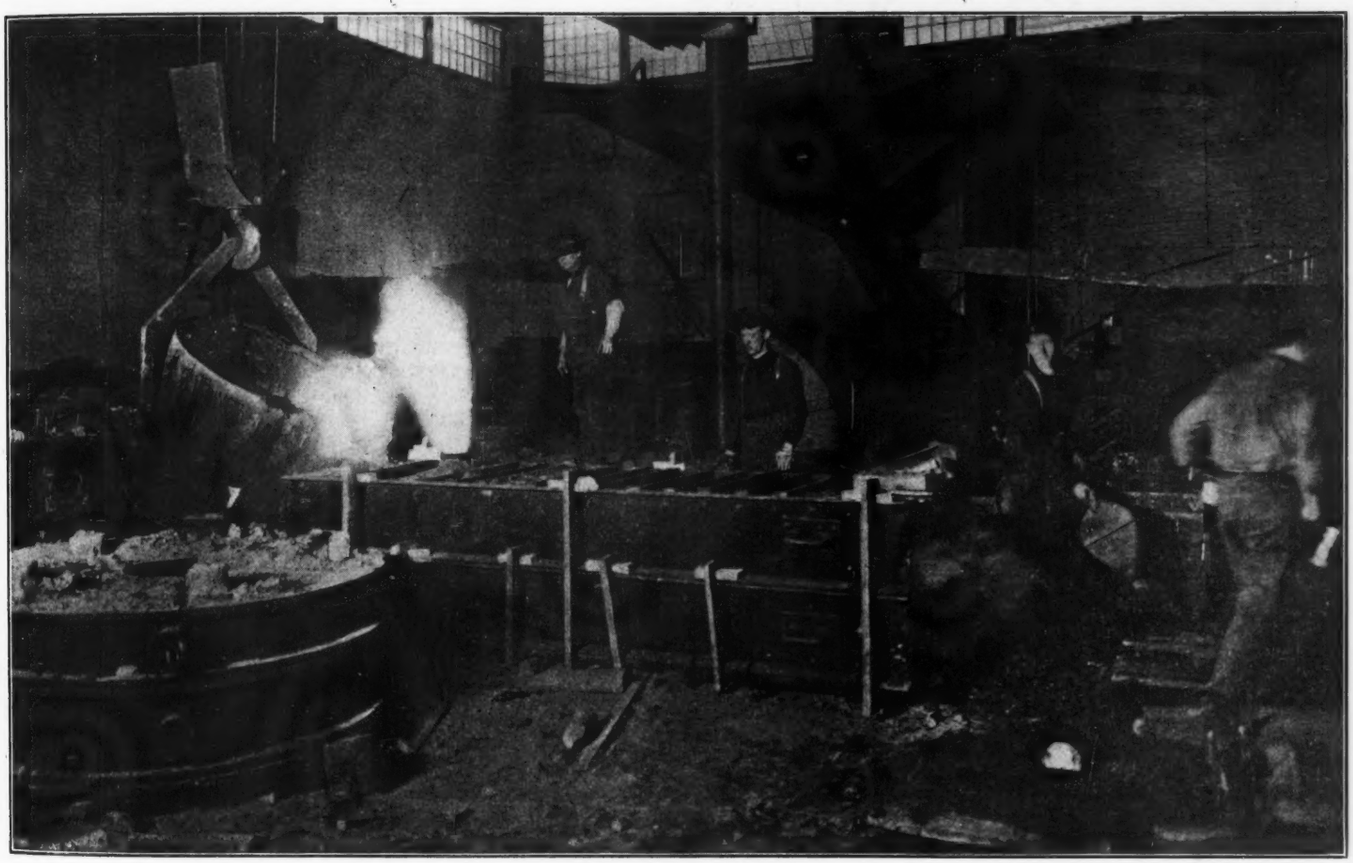
THE Columbia Engineering Works, of Portland, Or., have sent us their Bulletin S I, which gives an interesting description of their steel foundry, the only one in the entire Pacific Northwest.

The process and equipment employed must embody the latest experience in metallurgy of iron and steel, thus making possible a quality of output equal to that produced by any of the best steel founders in the country.

obtain the best quality of steel castings in a short time, instead of requiring several months, as formerly, is of untold advantage to the Western operator.

They have their own chemical laboratory, where analyses are being made constantly, both of the raw material used and of the finished product as it comes from the converter.

Their production comprises low carbon steel, mild steel, high carbon steel, nickel steel, manganese steel, chrome steel and hammeret high carbon steel.



FOUNDRY SCENE IN COLUMBIA ENGINEERING WORKS, PORTLAND, OR., SHOWING THE POURING OF 2000 POUND STEEL CASTING

The process in use is what is known as the surface blown converter system. By this method steel can be made to meet any required specification of toughness, hardness, etc., by the addition of carbon, manganese, nickel or other alloys necessary to make the desired mixture.

The making of steel castings on the Pacific Coast is of much importance to those operating machinery, particularly where such severe duty is expected as in the Northwest. To be able to

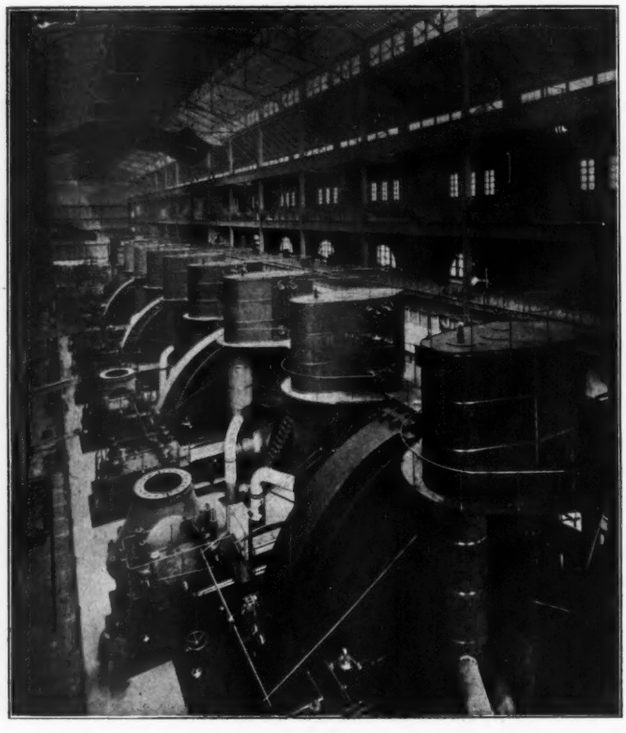
The Columbia engineering works keep a large assortment of patterns, a list of which will be gladly sent on application. They also have their own pattern shop, and are prepared to make patterns at regular rates. Excellent facilities are afforded customers desiring their castings machined before shipment. Boring, key-seating, turning, planing, drilling, milling or fitting work done promptly and well.

INTERBOROUCH RAPID TRANSIT COMPANY TEST OF SUBWAY ENGINES.

AN interesting official fifteen hour test of one of the nine twin vertical horizontal Reynolds Corliss engines, cylinders forty-two inches and eighty-six inches by sixty inches, which have been in operation at the Fifty-ninth Street station of the Interborough Rapid Transit Company, New York City, since 1902, was concluded December 15th. The tests were conducted by the Interborough Rapid Transit Company as a final determination of the fulfillment of the builder's guarantee and formally provided for in the original contracts.

How well the tests of engine No. 8, which was selected as representing all the engines installed, fulfilled the claims made for it, may be readily ascertained from the following data giving a synopsis of the completed tests.

As per agreement, on account of the impossibility of keeping a constant load, the power was determined by the readings of tested intergrating wattmeters. These readings were reduced to indicated horsepower by running the generator as a synchronous



FIVE OF THE ALLIS-CHALMERS 1200 HORSEPOWER SUBWAY EMGINES

motor; adding the electrical input to the switchboard readings when developing power, to obtain the power exerted by the engine.

The result of the test so made, under conditions approximating the contract requirements of 7500 horsepower, seventy-five revolutions per minute, 175 pounds steam pressure and twenty-six inches vacuum, was a consumption of 11.96 pounds of dry saturated steam per indicated horsepower-hour, or well within our guarantee of 12.25 pounds. The steam consumption per kilowatt hour at the switchboard was 17.34 pounds.

Duration	fifteen hours
Load	5079.2 k. w.
Friction and generator losses	417.3 kw = 559.41 horsepower
Total Load	5496.5 k. w.
Indicated horsepower	7366.3 horsepower
Revolutions per minute	75.02
Steam pressure	175.18 pounds
R. H. receiver	19.1 pounds
L. H. receiver	19.27 pounds
Vacuum	26.02 pounds (actual)
Temp. injection water	42.36 degrees
Temp. R. H discharge	74.05 degrees
Temp. L. H. discharge	77.38 degrees
Barometer	30.50 pounds
Water per hour	89.906 pounds
Drips per hour	512 pounds
Leakage per hour (boiler)	1.470 pounds
Boiler level correction	60 pounds
Net water per hour	87.864 pounds
Quality of steam	100.28 per cent.
Dry steam per hour	88.110 pounds
Dry steam per K. W. H	17.34 pounds
Dry steam per I. H. P	11.96 pounds

The final results allow for boiler leakage which was determined by a separate test of twenty-four hours duration. The steam was very slightly superheated during the test, as being easier to make allowance for than wet steam, and a correction was made to reduce the superheated steam to equivalent dry saturated steam.

The vacuum was carried at 26.02 inches, or as near the contract requirement as possible, but the barometer stood at 30.50 inches. The vacuum was, therefore, equivalent to only 25.52 inches referred to thirty inches barometer; no correction was made, however, as none was provided for in the contract. Other tests at varying vacua show that if the vacuum had been carried enough higher to correspond to twenty-six inches vacuum when referred to thirty inches barometer, the steam consumption would have been about 0.09 pounds better, or 11.87 pounds per indicated horsepower-hour instead of the official figure of 11.96 pounds.

The tests were under the supervision of Frank N. Waterman, who acted as referee. The following represented their several companies: Interborough Rapid Transit Company, H. G. Scott, superintendent motive power; J. Van Vleck, mechanical engineer; H. W. Butler, principle assistant engineer; Thomas Allsop, mechanical engineer, Fifty-ninth Street power station; C. W. Ricker, electrical superintendent; G. F. Chellis, instrument man; W. L. Seabrooke and W. S. Finlay, assistant engineers, and representatives of the Allis-Chalmers Company.

PROVED A SUCCESS.

THE Allis-Chalmers Company feel much pleased with the success that was achieved by their engines which were installed in the "subway" power house of the New York Rapid Transit Company.

Each engine was not to require more than 12.25 pounds of dry steam per indicated horsepower per hour, when indicating 7,500 horsepower at seventy-five revolutions per minute, with a vacuum of twenty-six inches at the low-pressure cylinders, with a steam pressure at the throttle of 175 pounds, said rating to include all steam used by the engine exclusive of auxiliaries.

These engines are of the well-known Allis-Chalmers-Reynolds horizontal-vertical type, each with two horizontal high pressure cylinders, forty-two inches in diameter, and two vertical low pressure cylinders, eighty-six inches in diameter; all of sixty inches stroke, with the two cranks set at 135 degrees. The high pressure cylinders have double-beat poppet valves, and the low pressure cylinders double-ported Corliss valves; all valves being in the cylinder heads. The cylinders are not steam jacketed, and no reheaters are used.

Apparatus as required for the test was installed as follows: For weighing the total feed water as delivered by the supply line, four tanks, mounted in pairs upon the twenty-four-ton scales, with a capacity per pair of 28,000 pounds of water, were used. The water from the weighing tanks was delivered to two reservoir tanks connected by equalizers, and then in turn to the boiler feed pump. For weighing of drips, leakage, etc., small scales and tanks were erected as necessary. Due allowance was made for all known leakage and drips. Readings were taken at fifteen-minute intervals, an hourly graphical log being maintained.

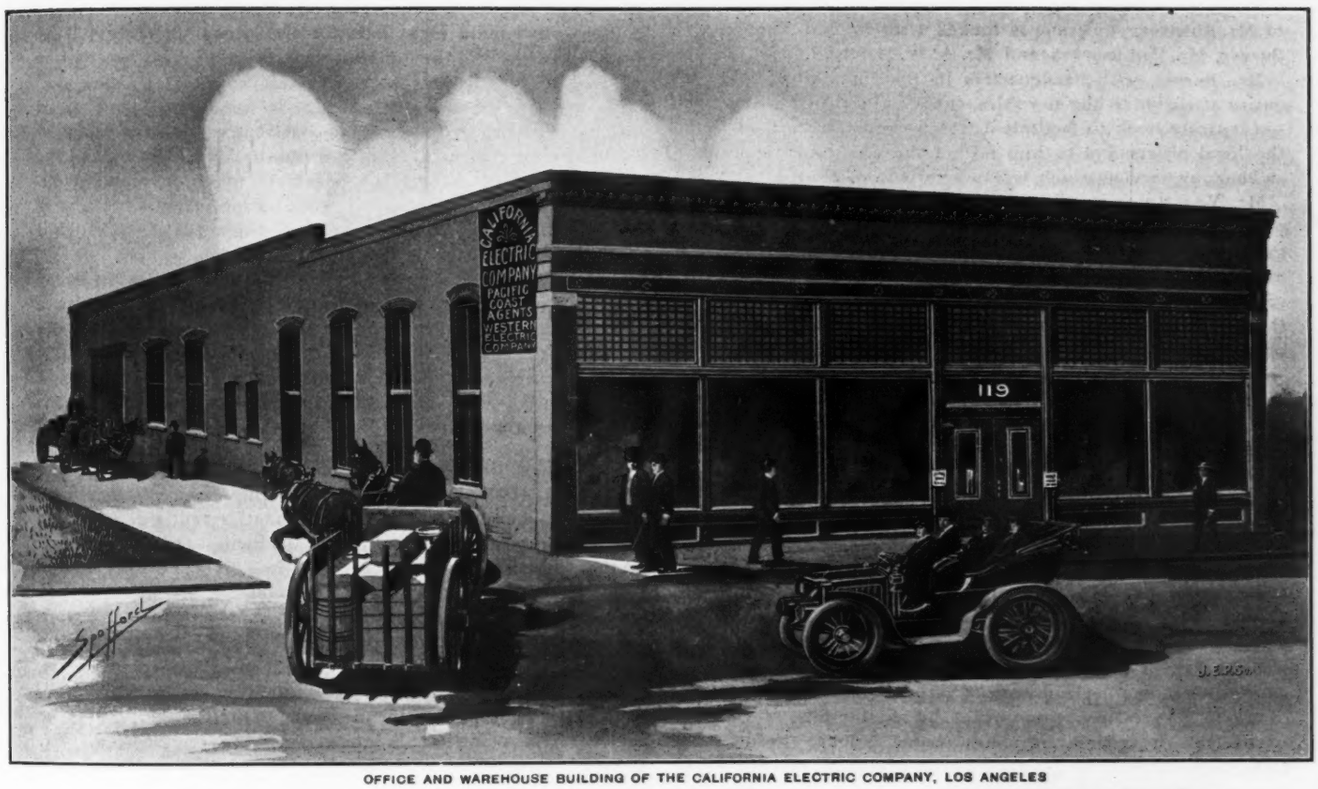
IN NEW QUARTERS

IN line with the rapid expansion of the electrical business in Southern California is the removal of the business of the California Electric Co. from their old quarters at No. 334 South Main Street to their new building at Nos 117, 119 and 121 East Seventh Street, Los Angeles where they are now located and where a largely increased floor space,

MR. W. F. GIBBS
SECRETARY AND TREASURER

MR. RICHARD SPENCER, MANAGER

MR. THEO. E. BURGER
SALES DEPARTMENT



OFFICE AND WAREHOUSE BUILDING OF THE CALIFORNIA ELECTRIC COMPANY, LOS ANGELES

MR. V. L. RUNYAN
SALES DEPARTMENT

MR. G. T. DONAHUE
SHIPPING DEPARTMENT

MR. A. W. HARRISON, ENGINEER

increase in stock and improved facilities enables them to take proper care of their rapidly growing trade.

A modern building with improved facilities would be of little value without a proper organization to appreciate its worth and use it to the best advantage. This the California Electric Company have. They have been unusually successful in bringing together a force of trained men, each experienced in his particular line and with a broad knowledge of the business and the customers' requirements.

Their numerous customers who transact business daily with them will undoubtedly be interested in knowing how this organization is made up and through whose hands their orders pass.

The entire management is in the hands of Mr. Richard Spencer, well and favorably known in the past as the manager of the Los Angeles office of the California Electrical Works, in which position he was successful in establishing a trade which afterwards became the nucleus of the present business. Mr. Spencer is ably seconded by Mr. W. F. Gibbs, who in his position as secretary and treasurer gives particular attention to the financial and clerical work. Mr. Gibbs will be well remembered on account of his previous connection with the Machinery and Electric Company, where his effective work and uniform courtesy made him hosts of friends.

In the sales department, which is under the direct supervision of Mr. Spencer, the trade is looked after by Mr. Theodore E. Burger, Mr. Van Runyan and Mr. A. W. Harrison.

Mr. Burger, with headquarters in the local store, gives his entire attention to the city sales, supervising the city sales stock —a separate stock to faciltate delivery—and the work of filling the local orders, and to him is due the credit for the prompt and snappy service which is characteristic of that department.

Mr. Van Runyan ably fills the position of road salesman, a position which in years past required more or less ability to relate the latest funny stories and distribute cigars. Mr. Runyan is capable of doing this at opportune moments, but in his intercourse with his customers he depends more particularly on thoroughness in his work, an accommodating disposition and a knowledge of the business which enables him to lay clearly before his customers the character of the service he is prepared to offer and the high qualities of the supplies he is handling.

Mr. Runyan has covered his present territory for about three months, but during that time has been very successful in establishing himself with the general trade.

Mr. A. W. Harrison has been known in Los Angeles in connection with engineering and automobile work for several years. His particular work includes the sales and supervision of installation of apparatus, arc lamps and storage battery equipment.

As representatives of the Electric Storage Battery Company of Philadelphia and San Francisco, this house being the Los Angeles exide station of that company, this branch of the business is with them an important factor. Mr. Harrison's past experience in engineering work of various kinds is of great value to him in his present position which he so ably fills.

After the customer's order has passed quickly through the sales, financial and clerical department it reaches what is probably one of the most important points in the organization—the shipping department.

In this department, under the management of Mr. Donahue, promptness and accuracy are safeguarded by a carefully worked-out system of records and checking, which has reduced complaints due to delays and errors to a minimum.

The receiving department is also under the supervision of Mr. Donahue, which is no small part of his work, in view of the frequent arrival of full cars, which must be handled qnickly and expeditiously.

What particularly impresses the visitors to these new quarters is the uniform activity, the atmosphere of hustle that pervades the entire place, and convinces one of the truth of their claim, that "every order is a rush order."

This spirit is a strong contrast with the spirit of the old mission days, which is still in evidence in Southern California, and an indication that with the coming generation the old spirit will give way entirely to modern vim and hustle and in a few years be merely a tradition of the past.

LARGE WIRE ROPE FACTORY IN SEATTLE.

ARCHITECT Max Umbrecht has been commissioned by the Broderick & Bascon Rope Co., of St. Louis, to proceed as rapidly as possible with their factories, warehouses and employes' houses in Seattle. One factory building will be of brick, concrete and steel, 200 feet long and seventy feet wide, and equipped with the most complete and up to date types of machinery for the manufacture of wire rope. All of the machines will be of designs patented by general superintendent E. P. Fredericks.

There will be facilities for testing wire rope to 200,000 pounds breaking strain, and all other physical tests necessary to the proper knowledge of rope-making will be ascertainable in the testing laboratory. All the welding will be done by electricity, which will also be used for all machines. As yet the company has not decided whether or not it will manufacture its own power. There will be a large warehouse, 175 feet long and ninety feet wide, besides numerous other buildings for storage, power and offices. On the main street, Eighth Avenue S., the company will build eight flats for the accommodation of the men at the heads of the different departments. The flats will be modern in every respect.

The Broderick & Bascon Rope Co. is the largest concern of its kind in the United States, and that Seattle has been selected as the site for the most extensive plant of the kind west of the Mississippi River has been the subject of much favorable comment among the business interests. Especial attention, it is stated, will be given by this company to the needs of the logging industry of Puget Sound.

Superintendent Frederick, who has had experience in every branch of rope making for the past thirty years, will exercise a personal supervision over the Seattle factory as well as over the factory at St. Louis. It is his intention to make the Seattle factory a very large one, characterizing the local market as a most extensive one. Architect Umbrecht will let his first contracts about a week hence.

HIGH SPEED IN MODERN ENGINEERING.

BA. BEHREND chief electrical engineer, Allis-Chalmers Company, Milwaukee and Cincinnati, recently delivered an address before the College of Mechanics and Engineering at the University of Wisconsin, Madison, Wis., entitled "High Speed in Modern Engineering." In this lecture Mr. Behrend laid stress upon the remarkable change that has been wrought during the past ten years in the field of prime movers and the fact that the reciprocating steam engine, which held its own for over 100 years, has gradually yielded, in a number of important fields of operation, to the rotating steam turbine, a change so radical that it may be said to have inaugurated a new epoch in engineering. Mr. Behrend discussed the conditions to be fulfilled for grappling with the difficult task of designing machinery for such high peripheral speeds as three and four miles per minute, and he showed how rotating bodies had to be shaped in order to uniformly distribute the stresses and minimize them so as to meet these conditions. The lecture was illustratrated with slides representing the stresses in rotating discs, and details of steam turbo-generators.

Mr. Behrend made the statement that the size of the generating unit in large power plants is going to increase considerably, and that during the next few years units of from 10,000 kilowatts to 25,000 kilowatts, wound for potentials of from 10,000 to 30,000 volts, are likely to be installed, as the steam turbine and generator lend themselves particularly well to units of very large capacity, and units of such capacity can be more readily wound for high potentials.

THE SCHWARZE UNIVERSAL BELL.

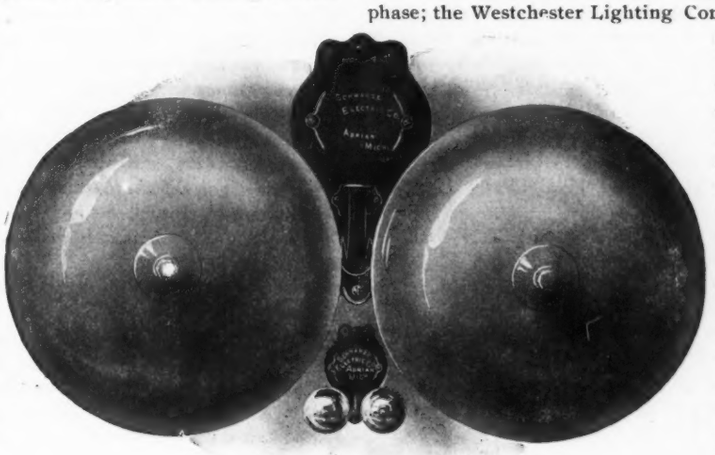
THIS bell is designed and constructed on perfect electrical and mechanical lines. A perfect bell because the electrical proportions are worked out on the most economical basis. While this is a radical departure from the old methods, no experiments are involved and new principles are used. Briefly summed up, the new features involved and points of superiority are:

Does not require local batteries for any length of time.
Does not open the circuit.
Does not arc or burn out contact points.
No adjustment or retractile springs used to work against magnet strength.
Will work with direct current of any voltage.
Strictly a main line bell and works perfectly on any length line.
Operates with either battery or dynamo currents.
Can be used on series or multiple lines.
No permanent magnets used.
No self-reaction in coils.
A perfect magnetic charge and discharge with high efficiency.
A constant flow of current in one direction.
No pulsations or reactions in coils.
Being constructed weather-proof, it requires no housing or other protection.

This bell, possessing these desirable features, makes it perfectly adapted for railroad signals, for use in mines and in chemical factories or industrial works, regardless of the conditions of the atmosphere.

Built in sizes from two and one-half inches to thirty inches cast bell metal gongs of the highest grade.

The Schwarze Universal Bell works perfectly for a telephone ringer where battery is used for signaling and has many advantages over the old style bell. Will work over one mile of No. 18 copper wire with two ordinary batteries. And the fact that the Schwarze Universal Bell can be worked in series is another economical feature for railroads. In case two or more bells are used at one highway crossing, the bells can be worked with one relay, instead of a bell for each relay as in the old way.



THE SCHWARZE UNIVERSAL BELL

Our Universal bell will operate with 80 per cent. less current than any other bell, this making a very desirable feature for crossing alarms, as it obviates the expense of maintenance both in batteries and repairs on relay contact.

Where this bell is used on battery circuits the current used varies in proportion to the length of the line and other resistance. The voltage necessary to operate the bell must be sufficient to deliver to the bell from four-tenths to six-tenths of an ampere.

It will be readily understood that this bell will work equally well on long circuits as it will on a short circuit, providing the quantity of current necessary to operate the bell is delivered to it.

This bell differs from all other forms of bells in this respect, that it will operate on any length of line and with all voltages without burning out the contact points, providing the current strength is kept from four-tenths to six-tenths of an ampere.

The same rules apply to the operation of this bell with a dynamo circuit as applies to the battery circuits. In the operation of this bell with a dynamo circuit there should be resistance put in on the line to bring the current down to the rated capacity of the bell—from four-tenths to six-tenths of an ampere. In order to use the 110-volt incandescent lighting circuit for operating the bell, a sixteen candle-power lamp is connected in series with the bell for resistance. If a number of bells are to be operated, two or three sixteen-candle-power lamps must be cut in in multiple series. In all cases it must be remembered in attaching these bells to incandescent circuits that the resistance must be put in series in order to not allow an excessive current to the bell.

The H. G. Aylsworth Company, 569 Mission Street, carry a complete stock of these bells and will be pleased to send full information on request.

ALLIS-CHALMERS STEAM TURBINES

FOLLOWING the starting of the 1500 kilowatt, Allis-Chalmers turbine unit at Utica, N. Y., sixty-cycle, 25,000-volt, two-phase, for the Utica Gas and Electric Company and the recent installation of a 5500-kilowatt, twenty-five-cycle, 6600-volt, three phase unit at the Williamsburg station of the Brooklyn Rapid Transit Company, the Allis-Chalmers Company has installed and now under construction 28,000 kilowatts in turbine alternator units. The New York Edison Company, New York City, has on order a 1500-kilowatt unit, sixty-cycle, 2500-volt, two-phase; the Westchester Lighting Company, New Rochelle, N. Y., a 1500-kilowatt, sixty-cycle, 13,200 volt three-phase unit; the United States Locomotive Equipment Company, Dayton, O., a 1500-kilowatt, sixty-cycle, 2500-volt, three-phase unit, and the Memphis Consolidated Gas and Electric Company, Memphis, Tenn., a 1500-kilowatt unit, 60 cycles, 2500-volt, 3-phase.

The City of Jacksonville, Florida, recently purchased two 500-kilowatt, sixty-cycle, 2300-volt, three-phase units and the Western United Gas and Electric Company of Aurora, Ill., will install a 500-kilowatt Allis-Chalmers turbine and alternator, sixty cycles, 2200-volt, two-phase. Three 1500 kilowatt units, sixty-cycle, 2300-volt, three-phase, have been purchased by John I. Beggs, president of the Milwaukee Electric Railway and Light Company, Milwaukee, for installation in the power house of the handsome new terminal station and office buiding, which is rapidly nearing completion. The latest additions to the list are the Kokomo, Marion and Western Traction Company, of Kokomo, Ind., recent purchasers of a 1000-kilowatt, sixty-cycle, 12,300-volt, two-phase unit, and the Western Canada Cement and Coal Company of Calgary, Canada, which has just placed an order for three units, each of 1000 kilowatts, twenty-five cycles, 600 volts, three-phase.

For direct connection to each of the turbines mentioned above, the Allis-Chalmers Company furnishes an alternating current generator of the well known "Allis-Chalmers" type, built at its works in Cincinnati, and especially designed to meet the required condition of service.

The United Electric Company, of Wichita, Kansas, recently purchased for the United Sash and Door Company, also of Wichita, an equipment of twenty Allis-Chalmers electric motors for direct driving the various wood working machines installed in the purchaser's mammoth plant, which is said to be as large as any of its kind in the world. The motors are of small size, types "B" and "N", many of them specified for ceiling suspension.

THE LUITWIELER PUMPING ENGINE.

THE Luitwieler Pumping Engine Company, Los Angeles, claim to have accomplished what has been heretofore considered impossible in securing a constant delivery of water without pulsation. The frequent stops and jars in the old style pump is entirely eliminated in the Luitwieler pumping engine and increased power with greater durability thus secured. They claim that on any kind of pressure duty the Luitwieler will excell other pumps 15 per cent. while for station pumping or for deep well work it can perform with a twenty five horsepower what a sinking pump or an air compressor would require from eighty to 100 horsepower. The Luitwieler pumps are balanced, have a straight line vertical movement, no back lash on gears or rods, and no water hammer in pipes.

In all reciprocating pumping mechanisms except the Luitwieler, the pump piston or plunger comes to the limit of its travel at the end of each stroke, and moves backward again to the place of beginning. As the water follows the piston, it necessarily follows that the water comes to a stop also at the end of each pump stroke. Water is solid and is non-elastic, consequently the stopping and starting again of a column of water produces the same effect as would be produced by the sudden stopping and starting of any other heavy body—it produces a jar. This jar is indicated all along the line of pipes by the noise, even though the pipes extend several hundred feet in length. If the pipes are in vertical position, as they must be in a mine or a tall building, the jar is very great, causing the pipes to leak at the joints, while the noise produced is wearing on the nerves of those who must remain in the building or the workings of the mine. The effect upon the pump is equally hard, causing rapid wear and expense to keep in working order.

The same cause that produces water hammer produces back lash in gears and pump-rods when operated by cranks, either single or double. The pulsating action of load and no-load on the gears at each pump stroke wears the gear teeth on both sides, causing a back lash and the accompanying disagreeable noise that can sometimes be heard a block away. This wear is rapid, the noise increasing with the wear.

Back lash in pump rods is traced to the same cause, the stopping and starting again of the water column, and as the rods move slow when the cranks pass the dead points and very fast when the cranks are at right angles to the pump-rods, the rod buckles when going down, striking the sides of the column pipe or drop pipe, wearing the rod couplings out unless pipe or rod guides are used to prevent this trouble. Rod guides cause friction and wear by rubbing against the column pipe, contributing to lower the already inefficient work of this type of pumping machinery.

As the Luitwieler pumping system is pulseless, there is no noise or back lash, no pipe joints to leak, the gears only show wear on the side of the tooth where the labor comes. There is no friction loss on rod or pipe, no use for rod guides, no necessity for check valves in pump barrels.

Luitwieler pumping engines are balanced. They convert a rotating movement into a straight line reciprocating movement.

The reciprocating mechanism consists of two cams and two crossheads. The two cams on the cam shaft are set opposite each other. The rotating movement is imparted by a spur gear on the outer end of the shaft, the whole, being perfectly balanced, revolves like a fly wheel. The two cross-heads have an anti-friction roller in the upper end of each cross-head that rolls upon the surface of each cam. These crossheads, being of equal weight, balance each other as they move up and down in planed guide ways like the window sash and weight.

The lower rollers in the crosshead move under an auxiliary track or cam, producing positive motion on the downward or return stroke of the pump. The above described mechanism they claim is the only reciprocating pump movement that produces a constant flow of water or that places a constant load on the driving power, and is fully covered by the Luitwieler patents

The pump rods and pump plungers attached to the crossheads, being of equal weight, moving up and down, balance each other, the whole moving in balance as one unit. So even is this balance that a man can, by placing his hand against the arm of a spur gear, rotate the whole mechanism easily, although it may weigh as much as fifteen hundred pounds.

The housings or frame of Luitwieler pumping engines are perfectly rigid, the complete mechanism being self-contained. The guide-ways and the crosshead guides are planed out of the solid metal. The friction area is large and reduces the pressure per square inch to a minimum. This pressure is so light and so evenly distributed over a large surface that the lubrication is perfect.

Modern methods of installing machinery place the driving power on the machine direct connected by gear, saving cost of separate foundations, floor space, saving cost of belts, the wear and tear on belts, effecting a saving in power as well. The whole being one unit, rigid and self-contained.

Luitwieler pumping engines are designed and constructed on well known mechanical principles, and along recognized and accepted mechanical lines, the object being to produce pumping machinery that is free from the many inherent defects and troubles found in the older types in use.

That their claims are recognized is shown by the increasing demand for Luitwieler pumping engines from the great railroads and water companies and other corporations who employ the best engineers.

The Luitwieler system of pumps are adopted for city and village water works, railroad tank service, irrigation, breweries, cemeteries, gas works, for manufactories, feeding boilers, condensers, ice factories, mining, paper mills, for fire protection, for pumping oils, chemicals, tar, air, molasses, soap, ammonia, water, brine, etc., etc.

The following are among the users of Luitwieler pumping engines:

Southern Pacific Railroad Company, Los Angeles, Cal.; Santa Fe Railroad Company, Los Angeles, Cal.; Salt Lake Railroad Company, Los Angeles, Cal.; Chihuahua Pacific Railroad Company, Chihuahua, Mex.; Potosina Electric Company, San Luis Potosi, Mex.; Montezuma Copper Company, Nacozari, Mex.; Mexican General Supply Company, Chihuahua, Mex.; Pinal Mountain Water Company, Globe, Ariz.; Tucson Ice and Cold Storage Company, Tucson, Ariz.; Phoenix Machine and Cold Storage Company, Phoenix, Ariz.; Indio Light, Water and Ice Company, Indio, Cal.; Highlands Domestic Water Company, Highlands, Cal.; Whittier State School, Whittier, Cal.; Pasadena Land and Water Company, Pasadena, Cal.; Calvary Cemetery, Los Angeles, Cal.; American Laundry Company, Los Angeles, Cal.; Palace Laundry, Los Angeles, Cal.; Chas Stern & Sons, distillers, Los Angeles, Cal.; California Portland Cement Company, Los Angeles, Cal.; Smith Ice and Package Company, Urbana, Ill.; University of Illinois, Urbana, Ill.; American Can Company, Hoopeston, Ill.; Hoopeston Canning Company, Hoopeston, Ill.; Illinois Canning Company, Hoopeston, Ill.; Village of Hazel Green, Hazel Green, Wis.; Richland County Asylum, Richland Center, Wis.; New Prague Flouring Mill Company, New Prague, Minn.; The Marion Light and Water Company, South Dakota; The Westminister Hotel, Los Angeles, Cal.; City of Summit, Illinois, Water Works; Beach Land Company, Playa del Rey, Cal.; City Water Works, Madrid, Ia.

Castle and Cook, Ltd., Honolulu, H. I., will install for Messrs. Alexander & Baldwin an Allis-Chalmers triple expansion horizontal double acting plunger pumping engine of the same size and type furnished by the same builder for the Hawaiian Commerical and Sugar Company. The capacity will be 10,000,000 gallons against a head of 370 feet, and it is expected to be ready for operation early in the fall.

ELECTRICAL EQUIPMENT OF THE LARGEST STORE IN THE WORLD.

INTEREST will be taken, says the *Electrical Review*, of New York, in the issue of March 3, 1906, in the equipment of the new Wanamaker Department Store in Philadelphia which will cover two city blocks. The building will be twelve stories high and cover 120,301 square feet. The power plant is about half a block from the store, connected by a tunnel.

The task which the architects have solved was to install the largest isolated plant in the country to-day on a plot of ground about sixty-five feet by ninety feet square.

By a very symmetrical grouping of the apparatus in straight lines along the length of the building, and leaving free room in between the building for piping and auxiliaries, it has been possible to eliminate double decking.

The refrigerating apparatus will be of the absorption type, exhaust steam being used for heating, and electric pumps for the ammonia machines and for circulating the brine.

The heavy elevator pumps and power pumps have been placed in a sub-basement along the west side of the building, the engine foundation being placed along the east side, the running board of the larger engines coming flush with the lower of two mezzanine floors opening from the engine room.

The boiler equipment consists of eight Babcock & Wilcox boilers, each boiler having 294 tubes four inches in diameter and eighteen feet long, arranged in nests of seven tubes wide and fourteen tubes high, under three steam drums thirty-six inches in diameter and twenty-one feet six and one-half inches long. The boilers are built to carry 200 pounds, the working pressure of this installation running at 140 punds.

In addition to natural draught, the boilers are equipped with induced draught fans in the stack and forced draught blowers in the furnaces.

The four induced draught fans were built by the American Blower Company, Detroit, Mich., and each are 180 inches in diameter, driven by direct-connected vertical engines. They each have a capacity for handling 51,000 cubic feet of gas per minute, and at normal speed will produce one and one-half inches draught water gauge when running 250 feet per minute, and two-inch draught water gauge when running 250 feet per minute. They are operated by General Electric Motors and Cutler-Hammer Speed regulators.

Directly below the boiler room is the boiler auxiliary room. The auxiliary apparatus includes four Knowles outside end packed, plunger, pot-valve pattern, fourteen inch by eight and one-half-inch by twelve-inch high-duty pumps, each having a capacity of 69,000 ponnds of hot water per hour, four Warren Webster & Company, Camden, N. J., feed-water heaters and purifiers and two large blow-off tanks. Suspended from the ceiling of the boiler auxiliary room are two feed-water tanks, each of 6000 gallons capacity.

On the second mezzanine floor there is also located a small air compressor plant, consisting of two Clayton air compressors driven by seven and one-half horsepower Crocker-Wheeler motors. There is a Cutler-Hammer automatic starter and speed controller which regulates the pressure so that when the tank is full the motors are automatically slowed down, and at the proper time cut out of service. When the pressure in the tanks has fallen to a predetermined point, the motors are automatically cut into service. The compressor is used for cleaning purposes and for handling oil for the lubricating system of the engines.

The five engines were built by the Southwark Foundry and Machine Company, Philadelphia, Pa., and are of a special cross-compound vertical type for isolated plant service. The two larger engines develop about 1500 horsepower each and are equipped with a 500-kilowatt, compound-wound, Crocker-Wheeler generator upon each end of the shaft, the flywheel being in the middle of the engine. The three smaller engines develop about 500 horsepower each and are equipped with 175-kilowatt, compound-wound, Crocker-Wheeler generators, one on each end of the shaft. The normal electric capacity is thus 3050 kilowatts. The engine room is served by a ten-ton motor-crane built by Alfred Box, Philadelphia, Pa.

All lighting in the power-house and in the store building is on the three-wire system, 220 volts being the drop between the outside line. A deep trench is arranged in the engine foundation to accomodate a slate panel board, upon which the lugs for receiving the flexible cables from the generators are mounted. From these panel boards the current is delivered to the switchboard bus-bars through flat copper bars six inches wide and five-sixteenths of an inch thick. Each conductor for the 500-kilowatt generators consists of four bare copper bars sweated into a lug which is bolted to the end of fuse clips. The bare copper bars are supported on insulators throughout the trench are carried behind a sheet-steel shield to the ceiling of the basement.

The switchboard was furnished by J. F. Buchanan & Co., of Philadelphia, the electrical contractor, and built by H. O. S. Engineering Company of Newark, New Jersey. This is probably the largest and most completely equipped switchboard which has been installed in an isolated power plant. The board is forty-seven feet wide and eleven feet high, built of polished marble mounted on substantial angle-iron frames and ornamental bronze supporting pedestals. The top of the board is ornamented with a handsome bronze grill work and the rear is protected by an expanded metal cage. The board faces the engine room and is composed of eighteen panels. Facing the board, and reading from left to right, these are as follows: four panels for the 500-kilowatt generators, six panels for the 175-kilowatt generators, one lighting totalizing panel, one power totalizing panel, three panels for the lighting mains for the store distribution. The power house main, and, in fact, all power are on the two-wire system, 220 volts.

Each of the generator panels is equipped with pilot lights, ammeters, circuit breakers, and for the 500 ampere circuits of 500-kilowatt generators a special form of toggle lever interlocking switch made by the General Electric Company, is used. The totalizing panels are equipped with Weston ammeters and voltmeters, a Bristol recording gauge, special indicator handles for taking the voltage on any of the circuits, and Thomson recording wattmeters. The lighting panels are equipped with pilot lamps tapped in on the proper circuits. The power panels are equipped with the usual switches.

In the sub-basement, in addition to the expansion tank and the water supply tank, are located the four elevator pumps, built by the Laidlaw-Dunn-Gordon Company, two deep pumps, the bilge pumps and four Westinghouse steam driven air-compressors. The sub-basement is also served by a ten-ton traveling crane built by Alfred Box, Philadelphia.

The new building is built in three sections—the north section the south section and the middle section. The north and south sections are separated from the middle sections by fire walls. At four points on each of these fire walls cabinets are erected on the different floors, taking the leads from the wire shafts. Each section of the new building contains a main switchboard in the basment. From this main switchboard the circuits are controlled for the different floors of the building. All circuits are carried in iron conduit through the wire shafts, and from the cutout cabinets arc and incandescent circuits are taken off for the general distribution. The load on the lighting mains, including incandescent circuits, are taken off for the general distribution. The load on the lighting mains includes incandescent lamps at 110 volts, and lamps at 110 volts, electric dumb-waiters and escalators at 220 volts, and electric fans and the electrically driven power house apparatus described above.

There are fifty-two passenger elevators, two large freight and van elevators, eight ordinary freight elevators, six sidewalk lifts in the store, one freight elevator in the power house—all of the hydraulic plunger type. In addition to this there are ten electric dumb-waiters.

A feature of the wiring installation is the complete conduit system for bell and telephone work. Arrangements have been

made so that it will not be necessary to rewire any part of the structure when equipping the present building with call-bells and telephones.

Wire shafts have been established with the outlet boxes all connected up, so that all that is necessary is to determine the location of the instrument and make the proper connections.

ELECTRIC PUMPING FROM A 2000-FOOT STATION.

RECENTLY at the South Eureka Mine, situated in Amador County, an electrically driven pump has been installed at its 2000-foot station by the Central Eureka Mining Company, a brief description of which may be of interest.

While the lift of 2000 feet vertical is not excessive compared with oil line pumping and hydraulic work of various kinds, nevertheless, it is as far as we know the highest single lift yet undertaken in California.

The pump in question is a Dow, horizontal, triplex, double plunger, pot valve, mine station pump, direct geared to a 150 horsepower Westinghouse motor, 440 volt three-phase, with a speed of 350 revolutions per minute. The current is conducted in lead covered armored cable. The line has been fused at two points; at the motor and at the top of the shaft, the latter fuse being about double the capacity of the former to guard against the necessity of the pump man going to the top of the shaft to fuse up every time an over load occurs. The fuses at the motor are of just sufficient capacity so that in the event of any trouble they go out The motor shaft is direct connected by coupling to the pinion shaft of the pump driving two steel pinions engaging in two machine cut heavy spur gears, which drive the three main cranks. The plungers are three and three-fourths inches in diameter by sixteen inches length of stroke. The pump has a capacity of 230 gallons of water per minute raised to the surface through a six inches flanged pump column. Most of the water of the mine is caught in a reservoir at the 2000-foot station with a capacity of 75,000 gallons from which the pump takes its supply. A check valve placed on the discharge manifold of the pump enables the motor to start without any load. The pump is supplied with a relief valve on the opposite side of the discharge manifold, set at a pressure of 1000 pounds. The discharge manifold is provided with two Dow improved spring compensating plungers, which control and subdue any agitation in the pump chambers and pump column. A test of the amount of power passing through a meter at the surface and the amount of water discharged at the surface by weir measurement, shows a total efficiency of 83.2.

ELECTRICITY IN THE CEMENT INDUSTRY

CEMENT is divided into two classes, slag and natural cement. In the manufacture of natural cement the rock is taken from the quarry or mines and burnt in a kiln. It is then run through a conical crusher, or between rolls and ground into a powder, after which it is conveyed to screens which separate the cement which is fine enough to be packed. The coarser particles then go to fine grinding machines which are ordinary mill stones, or emery-faced stones,

Considerable power is required in these cement plants and electricity is coming into general use. Either the alternating or direct current system is adapted to this work, the choice depending on local conditions. The plant of the Iola Portland cement works at Dallas, Texas, is equipped with Westinghouse type S direct current motors, and a contract just closed with the Santa Cruz Portland Cement Company, San Francisco, Cal., gives a good idea of the size of some of these plant. This order calls for one 800 horsepower type C motor, ten 250 horsepower, fifteen 150 horsepower, one seventy-five horsepower, and one thirty horsepower type CCL motors. These are all alternating current motors of the induction type and aggregate a total of 5655 horsepower.

The offices of *Gas and Oil Power* have been removed to the Chamber of Commerce Building, 3 Oxford Court, Cannon Street, London, E. C.

A PELTON EFFICIENCY TEST.

ALMOST gratifying report has just been received as to the operation of the two Pelton water wheel units recently inatalled by the Nevada Power, Mining and Milling Company, of Bishop, Cal. The installation consists of two 750-kilowatt, 450 revolutions per minute, generators, each direct connected to a Pelton water wheel operating under a static head of 1065 feet, and transmitting power to the Goldfield and Tonopah districts of Nevada.

The water wheels were sold under a rigid guarantee that they would develop an efficiency of 80 per cent., and a series of exhaustive tests were conducted by the engineers of the Nevada Power, Mining and Milling Company under the following conditions.

The station load was first carried by unit No. 2 and the tests made on unit No. 1. The test load was carried by a water rheostat, and measurements of the energy were made by Westinghouse intergrating watt meters. These readings were also taken by volt meter and ammeter readings. The load was constant and the test extended over one and one-half hours. The electric, windage and friction losses of the generator were afterwards obtained by running the generator as a motor. The water pressure was measured by a gauge attached to the pipe just back of the gate, and an allowance was made for the velocity head, which was, however, small at this point. The water was measured by an accurately constructed weir in tail race. Taking the readings of the watt meter, and adding to it the power necessary to run the generator as a motor, it was found that of the total theoretical energy of the water as it entered the nozzle, the wheel delivered to the shaft of the generator eighty-two and eight tenths per cent. (82.8%.) Thus the high efficiency of 82.8 per cent. was obtained by the Pelton wheel. The test was made under the supervision of Engineer J. D. Galloway, assisted by the superintendent of the electric plant.

This company is now installing a third Pelton wheel of 3000 horsepower capacity in the same station.

The Pelton Company has received an order from the Orient for a complete Pelton equipment to operate under two separate heads, conditions being such that two independent streams afford heads of 630 feet and 420 feet respectively, with varying water quantities. This involves two wheels of different diameters mounted on the same shaft, which is direct connected to an electric generator by means of Pelton flexible leather link couplings. A single governor controls both wheels by means of stream deflecting hoods on the nozzles. Also from the Orient comes an order for an iron mounted Pelton unit for driving a 300-kilowatt generator under an effective head of 580 feet, the wheel to have 500 horsepower maximum capacity.

The Alaska Electric Light and Power Company has ordered a three wheel double nozzle unit for operating under a head of 225 feet.

From a large corporation in British Columbia was received an order for a Pelton unit with which is incorporated 15,000 feet of sheet steel riveted pipe. The Pelton Company has recently increased its pipe works in the East and is now prepared to turn out sheet steel riveted pipe of any length, diameter or thickness, having exceptional facilities for the manufacture of this class of pipe, as well as the highest grade lap-welded pipe in all diameters and thickness, for high duty power transmission lines.

The Iron Silver Mining Company, Leadville, Colo., whose head offices are in Detroit, recently completed the purchase of a Reynolds heavy duty air compressor, capacity 1000 cubic feet of free air per minute to 100 pounds pressure and a 17 x 12-inch steam driven Reynolds individual jet condenser, with a capacity of 5000 pounds of steam per hour. The new equipment will be furnished by the Allis-Chalmers Company, Milwaukee, and is for the company's N. Moyer shaft, where it will be put in place under the direction of the purchaser's superintendent of mines, Mr. O'Brien, early in May.

AN INVESTIGATION OF THE DOBLE NEEDLE REGULATING NOZZLE.

DURING the past twenty-five or thirty years, a great deal has been done to increase the efficiency of nozzles with the idea of using the streams for fire and power purposes. The first scientific experiments of any consequence were those made by John R. Freeman in 1888 at Lowell, Mass. He made

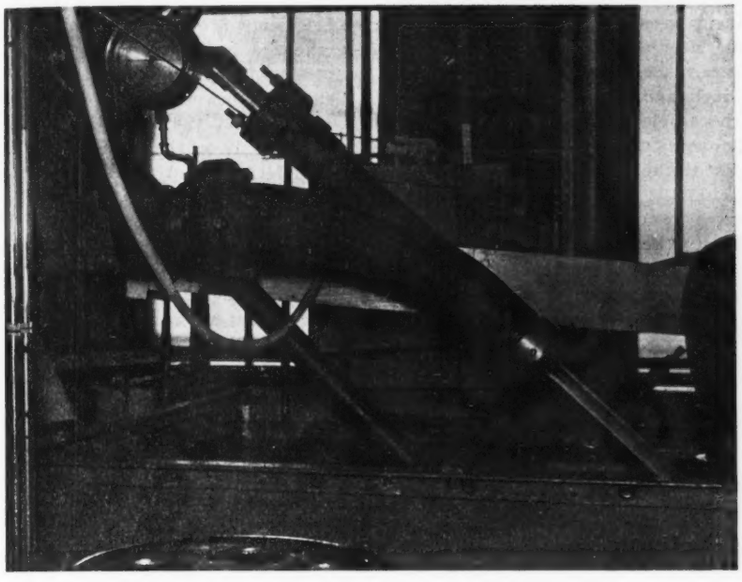


FIGURE 1. DOBLE NEEDLE REGULATING NOZZLE ARRANGED FOR TEST.

a very extensive and complete series of careful experiments as regards the use of nozzles for fire streams. During recent years, there has been considerable study of nozzles to be used under high heads for power purposes, the result of these investigations being the production of the needle regulating nozzle.

A short time ago, Messrs. H. C. Crowell and G. C. D. Lenth conducted a series of very interesting experiments at the Massachusetts Institute of Technology, on the subject of streams from different types of nozzles. For purposes of determining the efficiency of the needle nozzle, the institution purchased one of the Doble type. The results of the tests have been embodied in a thesis from which the following interesting facts have been abstracted.

The nozzle which is shown in Figure 1 is described as follows:

"This is a special design, but similar to those now in use in connection with tangential water wheels in many large power plants on the Pacific Coast. It consists in the main of a large steel casting which is connected at the left, in Figure 1, by means of a flange coupling to a six-inch piezometer ring and that in turn to the six-inch pressure pipe. The characteristic features of the Doble nozzle are the tip and the needle regulator within it on the right. The tip has a carefully ground and polished inner surface and is screwed on to the casting. The needle is highly polished and has a shape similar to a plumb-bob, such as is used on an engineer's transit. It is attached to a steel spindle extending back within the upper fork of the casting. About eight inches from the end of the spindle is a square-threaded screw which runs through a steel nut fastening by means of two bolts to the casting. There is at the end of the spindle a hand-wheel, which is used to regulate the position of the plumb-bob. When the hand-wheel is turned right-handed the needle moves outward, and, consequently, the area of the orifice and the diameter of the stream is decreased."

In regard to the stream from the different nozzles, the following is stated:

"Viewing the stream of water as it issues from the Doble nozzle, one's attention is at once called to the clear, transparent, polished stream, the clean glassy surface, and the absence of spraying in the proximity of the tip. The reason for this was the point first sought after. Photographs were taken of various streams of water and the usual ground-glass appearance of the stream from the regulation conical fire nozzle is quite perceptible to the eye. In the stream from an ordinary straight pipe, the feathery appearance is quite marked. In the ring nozzle, we see at once the same opaqueness but less spraying. At first, it was thought that the disturbed condition of the jets from the conical and ring nozzles was due to air in the water, and so we experimented with the standard tube, and found that under normal conditions the stream was similar to those above described. We then permitted air to enter the standard tube by means of a stop-cock about one inch from the side of the reservoir. Immediately the condition changed. Thinking that we could find the 'vein of contraction' in the standard tube, we had made a standard tube of glass, two inches in diameter. There was, however, no vein of contraction visible to the eye, but there existed in the tube a pressure less than that of the atmosphere. This was demonstrated by carefully inserting along the inner side of the tube a small glass tube. At first as the small tube was slipped into the larger one, water was forced out of the former. There was, however, no change in the general appearance of the stream; but when the end of the tube was about three inches from the side of the reservoir, there was a great disturbance of the water in the large tube, and the stream left in a semi-transparent condition.

"The conclusions drawn from these experiments are: that the usual feathered appearance of the stream from ordinary nozzles

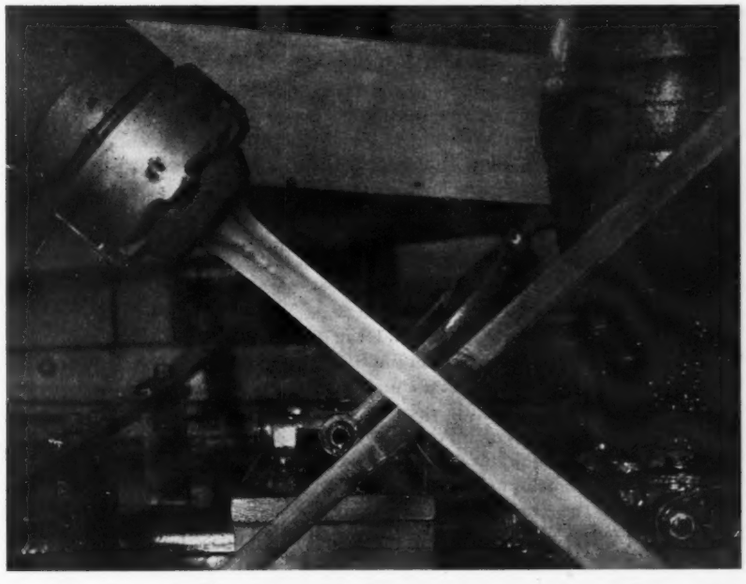


FIGURE 2. DOBLE NEEDLE REGULATING NOZZLE UNDER TEST—NOZZLE WIDE OPEN.

is due not to the air in the nozzle itself, but to the difference in the velocity of the particles of water. The velocity in the outer layer is decreased; this fact is shown by the velocity curves of jets from ring, conical and Doble nozzles. The amount of retard-

ation of velocity of the outer layers determines the degree of feathered appearance, and we believe this excessive retardation is due to the friction of the outer layers of water on the inner surface of the nozzle."

By means of a special Pitot's tube, a complete series of tests were made to determine the distribution of velocity on the jets. Owing to the remarkable symmetry of the velocity curve that was found whenever a complete traverse of the stream was made, it was decided to measure the velocities only in the half of the stream nearest the instrument. Traverses of the stream were made for three different heads and five settings of the needle regulator. For two settings of the needle, traverses were made across six sections of the jet varying between one-half-inch and ten inches from the needle. Figure 2 is a view of the Doble needle regulating nozzle under test with the nozzle wide open.

Following are stated some of the interesting results of the tests made by Crowell and Lenth:

"The most significant feature of all the velocity curves from the Doble nozzle is the fact that the maximum velocity in the streams occurs within a few hundredths of an inch from the edge. This condition is obtained in streams from no other nozzle except the ring nozzle. Another surprising feature is the high velocity existing in the center of the jet from the Doble nozzle, even within a half-inch from the needle. The velocity in the center is 70 per cent. of the maximum velocity; an interested spectator predicted that it would be less than 50 per cent. At nine and one-half inches from the needle the center velocity is over 96 per cent. of the maximum velocity. With one setting of the needle the area of retarded velocity at nine and one-half inches from the needle was found to be over twice the area of retarded velocity near the needle; with the other setting this area was more than trebled. Notwithstanding these changes that are rapidly taking place near the center of the stream, the velocity of the particles of water near the edge is changed almost imperceptibly, and the stream maintains its smooth, glassy appearance for a long distance from the nozzle.

"The second and perhaps the more important part of the experimental work was the determining of the efficiency of the jet from the Doble nozzle. The efficiency of a jet is equal to the ratio of the velocity head in the jet to the total head at the entrance of the nozzle; or, in other words, the efficiency is equal to the square of the coefficient of velocity. In determining the efficiency of a jet three important measurements must be taken: The pressure at the entrance to the nozzle; the diameter of the stream (or of the nozzle if there is no contraction of area); and the discharge. In our experiments the pressure at the piezometer ring was measured by means of a mercury gauge; the errors in this part of the work, even when the pressure was low, are not over one-quarter of 1 per cent. for the experiments under constant head. The diameter of the stream could be calipered only to the nearest hundreth of an inch, and the error in the computed area may be nearly 1 per cent. in the case of streams with small diameters. The discharge was measured in a large tank, eight feet in diameter, with a capacity of 250 cubic feet. Several measurements were taken during each run and the average discharge is probably not in error by more than one-half of 1 per cent.

"Twenty experiments were made under different conditions of head and setting of the needle regulator. In seventeen experiments constant head was maintained by use of the stand-pipe. In three experiments the water was pumped directly through the nozzle. The efficiencies under constant head vary from 96.4 to 99.3 per cent.; the corresponding coefficients of velocity vary from .982 to .997. The results, especially those for low heads, are exceedingly gratifying, showing, as they do, the marked superiority of the Doble nozzle over all forms of conical nozzles. It was hoped that the results would show how the efficiency varied with the head; but the unavoidable errors in the measurements of the discharge and of the head when high make it impossible to draw any definite conclusion as to the relation of efficiency to head. It was also thought that perhaps the results would show how the efficiency varied with the setting of the needle regulator; but the impossibility of measuring the diameter of the stream with any considerable degree of accuracy without exceedingly elaborate and costly apparatus, makes it unjustifiable to draw any definite conclusions as to the relation of efficiency to the setting of the needle. However, it may be said that with the very smallest streams the efficiency is certainly lower, and that with the very largest streams the efficiency is probably lower than with intermediate sizes.

"It should be noted that the efficiency is obtained by dividing the velocity head in the jet by the total head at entrance plus the difference in elevation of the center of the piezometer and the section of the jet where the diameter is measured. This last term was 1.0 feet. It should also be noted that the diameter of the stream depends not on the head, but only on the setting of the needle. Careful experiments under different heads failed to show any change in the diameter."

The needle nozzle used in the tests and illustrated herewith was purchased from the Abner Doble Company of San Francisco, who have for several years made a specialty of high-grade tangential water wheels and needle regulating nozzles for all classes of hydro-electric and general power plant work.

BIG INDUCTION MOTORS FOR THE ANACONDA, COPPER MINING COMPANY.

Four of the largest induction motors ever installed in the west and some of the largest in the country, with the the exception of those installed at Niagara, will be used to furnish power at the $9,000,000.00 reduction plant of the Anaconda Copper Mining Company, Anaconda, Montana.

The Allis-Chalmers Company of Milwaukee, will furnish this electrical equipment for the mammoth 8000 ton concentrator and the street railway company at Anaconda.

CURTIS TURBINE FOR UNIVERSITY OF WISCONSIN.

The University of Wisconsin has recently purchased from the General Electric Company a twenty-five-kilowatt, horizontal type Curtis steam turbine for the instruction of students and for experimental purposes. Owing to the increasing importance of this type of machine in electrical plants as well as the recent successful application for ship propulsion, the college of engineering considers itself particularly fortunate in securing this valuable addition to its laboratory equipment.

ELECTRICITY IN CHINA.

Consul-General Guenther, of Frankfort, reports that, according to a statement of the *Revue Scientific*, of Paris, the Emperor of China has instructed his minister at Paris, Sueng-Pau-Ki, before his return to Peking, which will shortly take place, to study the state of the electrical industry in France and to make a report. The minister has commenced inspecting the most important electric establishments in Paris and other places. From this it would appear that China will follow the example of Japan and pay more attention to the industrial sciences.

REMOVAL NOTICE.

The Electric Storage Battery Company, of Philadephia, will move its San Francisco office from 326 to 622-624 Rialto Building, and will be pleased to receive its patrons and other friends in the new quarters on and after March 5, 1906, R. B. Daggett is manager of the San Francisco office.

The John M. Klein Electrical Company reports a large sale of Federal steel porcelain enameled sectional signs. Many orders received of late from southern and central California have necessitated a large increase of their shop force. In order to prepare for the summer trade, they have placed exceptionally large orders to take care of this rapidly increasing business.

OIL CIRCUIT BREAKER.

THE electrically operated oil circuit breaker, type 9, was designed by the Westinghouse Electric and Manufacturing Company for the Ontario Power Company's work. It is intended to handle energy up to 60,000 horsepower per three-phase circuit, and will open a circuit under any conditions of overload or short circuit which may occur with a power house capable of delivering 200,000 horsepower. The insulation to ground and between terminals is designed to withstand a break-down test of 150,000 volts, and the insulation between poles is twice that amount since the poles are electrically separate.

The three poles of the switch are closed together by means of a toggle joint operated by a single direct-pull solenoid. The switch is held in a closed position by the toggle being carried just beyond the center and is tripped out by the tripping coil armature striking this toggle and knocking it backward, allowing the switch to open by gravity. Each pole of the switch gives a double break, each break being approximately seventeen inches. The closing magnets require approximately 5000 watts direct current, while the tripping magnets require about 300 watts.

The three oil tanks, are made of boiler iron lined with an insulating material with barriers interposed between the stationary contacts. The contact parts are of their standard type C construction, having renewable arcing tips and contacts. The leads with their insulation and the upper porcelain insulators may be readily removed from the switch, giving access to the contact parts for inspection and repairs. The top covers of the tanks are made of treated soapstone slabs, part of which are also removable. Each tank is provided with an oil drain opening in the bottom and an overflow just above the normal oil level. These openings are provided with standard three-inch pipe flange threads, but no pipe is provided. Each tank has an oil level gauge and requires approximately 160 gallons of oil.

The total weight of each three-pole switch complete, the tanks being filled with oil, is approximately 15,000 pounds. The oil alone weighs approximately 4000 pounds.

A two-pole double-throw indicating switch is provided upon each three-pole oil switch for use in connection with the controlling and indicating devices. The circuit breaker is not automatic in itself, an overload relay operated from series transformers being necessary.

NEW WATER LIFTING DEVICE.

A NEW water lifting device, the "Columbia Hydraulic Ram," has recently been perfected by Fred Hesse, a practical hydraulic engineer of Portland, Or., who has applied for patent papers on his invention. The machine, which it appears has been evolved from a long series of hydraulic experiments and observations of similar devices on the part of the designer, proves a decided advance over anything which has heretofore been placed upon the market. The ram is of the horizontal type, and the waste valve is so constructed as to allow a practically unimpeded flow of water in the original direction, resulting in greater capacity and higher efficiency than that of its competitors. Another decided advantage of this ram is the absolutely positive and automatic air supply, attained without any special valve, as has been the practice heretofore. The number of impulses is regulated by a pendulum, the weight of which may be raised or lowered, according to requirements. The ram, which has been subjected to the most rigid tests for the last six months at the experimental station of the Columbia Engineering Works, proves to be almost free from shocks, highly efficient, and is of a construction so simple that any non-mechanic can put it in operation with the aid of a few written instructions accompanying the machine. We are informed by Mr. Hesse that he has transferred the sole right of manufacture to the Columbia Engineering Works, of Portland, Or., who will place the ram upon the market in sizes ranging from one-foot to six feet. The machine is designed to supply the need of the small irrigationist, railroad supply tanks, small municipal requirements, etc.

SINGLE PHASE ALTERNATING CURRENT EQUIPMENT FOR MILWAUKEE ELECTRIC RAILWAY AND LIGHT COMPANY.

THE advantages attending the use of alternating current for operating conditions of interurban trolley lines, are again emphasized by the announcement that another company is about to install this system. In the South and West where long distance trolley lines with few stops are more numerous than in the more thickly settled eastern portions of the United States, the alternating current system has been sucessfully adopted by several companies, and the latest to decide upon this method is the Milwaukee Electric Railway and Light Company, of Milwaukee, Wis. This company is about to equip two suburban extensions of its lines with the alternating current apparatus manufactured by the General Electric Company, of Schenectady, N. Y. One of these lines will extend from Waukesha to Oconomowoc, a distance of twenty miles, and the second will operate between Hale's Corners to Mukwonago, a distance of sixteen miles. Both lines will be operated at a potential of 3300 volts, and in addition the motors are designed to run on the existing seven miles of 550-volt direct trolley line between West Allis and Milwaukee.

The motors to be furnished for this equipment are the standard General Electric alternating type. Each of the ten cars comprising the initial equipment for the road will be furnished with four motors of seventy-five horsepower each, known as the GEA-605.

These equipments will in general be operated as single cars but occassionally will be run in two car trains. For the flexible control of these train combinations the well known Sprague General Electric system of multiple unit control will be used, adopted for operation on alternating current.

Distribution of the various transformer substations on this line, will be at 33,000 volts. At the stations the current will be fed to the trolley line at 3300 volts. For this latter the General Electric catenary construction will be used. It is proposed to have this line in operation during the fall of 1906.

THE BENJAMIN ARC-BURST.

ALTHOUGH on the market little more than a year, the arc-burst has become so well known that a descriptive article might now appear unnecessary, were it not for the fact that the growing demand has encouraged the manufacturers to produce new and improved types to which it is our purpose to call attention.

In the latter styles of arc-burst, the highest point of illumination is attained, with few of the disadvantages that accompany the use of other light producers. The brilliant, yet noticeably soft and steady, light of the arc-burst suggests its use for a wide range of conditions where satisfactory results are difficult to obtain, and compared with the flickering and unsteady burning of even an up-to-date arc lamp, its merits are at once apparent. A special wireless cluster forms the base of the arc-burst, around which are placed high efficiency Meridian type lamps, together with appropriate reflectors, so designed and placed in relation to the lamps that the light produced is radiated in the most effective manner.

Among the advantages of the arc-burst may be mentioned the fact that it has the strength of the arc lamp without the hissing and sputtering, the pleasing light of incandescent gas mantles, and that the cluster, even when not in use, is an ornamental addition to any establishment.

The John M. Klein Electrical Company has just received a complete stock of the various specialties manufactured by the Holtzer-Cabot Company. The Holtzer-Cabot Electric Company manufacture a line of goods unexcelled by that of any other manufacturer. It is gratiying to know that the trade will be able to obtain this material from San Francisco stock, as the inability of the trade to secure this line of goods has been a great handicap in the past.

ELECTRICS AT THE WASHINGTON STATE UNIVERSITY.

SOME very interesting high-tension electrical experiments were performed by J. B. Ross, head engineer of the Seattle Electric Company, at the "open evening" entertainment given March 24th by the Physics and Electrical Engineering Department of the Washington State University in the Administration Building, Seattle.

Prof. Osborne had charge of the program. He personally conducted an experiment showing the action of electrical waves. John Dewhurst operated the wireless telegraph in communication with a similar station at the Seattle High School. Other important features were included in the program.

Coming so soon after the 200th anniversary of the celebration of the birth of Benjamin Franklin, a short address was delivered in Denny Hall on his scientific works, shortly before the entertainment began. A meeting of the Puget Sound Science Club was held at the University on the afternoon of the same date.

A 9700 HORSEPOWER HYDRAULIC TURBINE

AN interesting point in connection with the recent purchase by the California Gas and Electric Corporation, San Francisco, of a 9700 horsepower, single horizontal, spiral case, reaction hydraulic turbine, is contained in the fact that this turbine will operate under a 550 foot head at a speed of 400 revolutions per minute, which is the highest head under which a turbine of this type has ever been installed. Until recently, manufacturers of secondary machinery have avoided the operation of their apparatus on high speeds. This prejudice, however, has to a great extent been overcome, and it is only a question of time when this type of hydraulic turbine will be constructed for still higher heads than the present practice will allow.

This turbine and accessories will be furnished by the Allis-Chalmers Company, of Milwaukee, and is destined for installation at Chico, Cal., where the corporation controls the water rights.

MILLION DOLLAR POWER PLANT.

IN Los Angeles recently a $1,000,000 contract was awarded for the creation at Redondo of one of the greatest steam power plants west of New York. When completed the plant will have few equals in the United States.

The increasing need of the Los Angeles Railway Company for more power to operate its lines is one of the main reasons for the enterprise. Sufficient energy will be generated, however, to supply an enormous demand aside from that of the Los Angeles Railway Company.

The parties to the big contract are the Pacific Light and Power Company, at the head of which stands H. E. Huntington, and C. C. Moore & Co., engineering contractors of this city. The energy to be generated is placed at 25,000 horsepower, and the amount named for steam and electric equipment is something more than $1,000,000.

Added to this will be the cost of the building that is to house the machinery. This figure is placed at $250,000, making the total cost of the plant about $1,250,000. Work on the plant will begin within sixty days, and the great power factory will be in operation within one year, according to those interested.

BROWN-SPEAR-SLOANE COMPANY.

The recent large "copper order" placed by the Edison Electric company of Los Angeles for their Kern River development, and amounting to over $500,000.00 is one of the largest single orders for transmission wire placed for some time. Brown-Spear-Sloane Company were successful in securing a third of the order for their principals, the American Electric Works of Phillipsdale, R. I. The remainder of the order was shared equaly between Roebling and the National Conduit and Cable Company.

Condulets, the new conduit box and fitting recently placed on the market by the manufacturers, has taken the Eastern trade by force and is becoming very popular with the "man with the conduit job". As this is the "newest" approved fitting and is the only thing of its kind on the market there is no doubt of it's assured popularity with the Western trade. Brown Spear-Sloane Company are showing some very pretty samples and will carry a full line of the material in San Francisco.

BIG PUMPING ENGINES FOR SUGAR REFINERY.

The American Sugar Refining Company has completed arrangement for the mechanical equipment for their Chalmette plant, New Orleans, La. Orders have been placed recently for six horizontal, Reynolds-Corliss power engines, 500 horsepower each, and two horizontal, double acting plunger pumping engines each having a capacity of 12,000,000 gallons daily against a head of 125 feet. The power engines which are of the heavy duty type will be arranged in two groups of three each, one for direct connection to 350 kilowatt alternating current generators, and the other belt transmission.

The Chalmette refinery plant will be equalled by few for the size of its units, and for economy in operation. The pumping engines are particularly noteworthy on account of their capacity for installation in an industrial establishment. The Allis-Chalmers Company, Milwaukee, will furnish the entire equipment.

BYRON JACKSON MACHINE WORKS.

A. B. Cone has been engaged by the Byron Jackson Machine works as northwestern manager and a branch office and salesroom has been opened at 55 First Street, Portland, Or. They will carry at this office a full line of their high efficiency centrifugal pumps, and will be prepared to contract for the installation of complete power and irrigation plants, for either steam, electricity or gas, with all necessary fittings and accessories. Mr. Cone reports an exceptionally bright prospect for business, as the demand for hydro-electrical equipment is constantly on the increase in the Northwest. Mr. Cone's long acquaintance and experience in the power field admirably qualifies him to establish and develop the sale of the Byron Jackson Pump in his territory.

THE SEATTLE ELECTRIC COMPANY.

The electric light companies and the dealers in electrical goods in the Northwest have found it a great convenience to be able to obtain their supplies from the large and varied stock carried by the Seattle Electric Company, who make a specialty of selling at wholesale. They carry full lines of electric generators, motors, transformers, insulators, meters, batteries, fixtures, lamps, signs, wire, and heating and other devices, and are able to make quick deliveries. The electric trade is becoming more and more accustomed to depend upon them for replenishing their stocks.

THE UNITED STATES CAST IRON PIPE AND FOUNDRY COMPANY.

The United States Cast Iron Pipe and Foundry Company, the largest manufacturers of cast iron pipe in the United States, have established an office on the Coast in San Francisco in charge of R. W. Martindale, as Pacific Coast manager, having sales room and office at 620 Rialto Building. This company sells pipe for water and gas direct to the user, and heretofore have been little known on this Coast as their business has been done through commission houses, but hereafter will be done by the company direct.

The National Electric Company of Milwaukee, Wisconsin, reports having closed a contract with the Edison Illuminating Company, of Detroit, Mich., for four 500-kilowatt motor generator sets to be used for railway service.

INSTALLATION OF NEW MULTIPLE SWITCHBOARDS BY THE TELEPHONE COMPANY TO IMPROVE THE PUBLIC SERVICE.

VAST sums of money are being expended by the Pacific States Telephone and Telegraph Company for improvements in its San Francisco system. Among the most prominent improvements, and one that will bring the service to the highest state possible to attain, is the installation of four new improved "Multiple" switchboards.

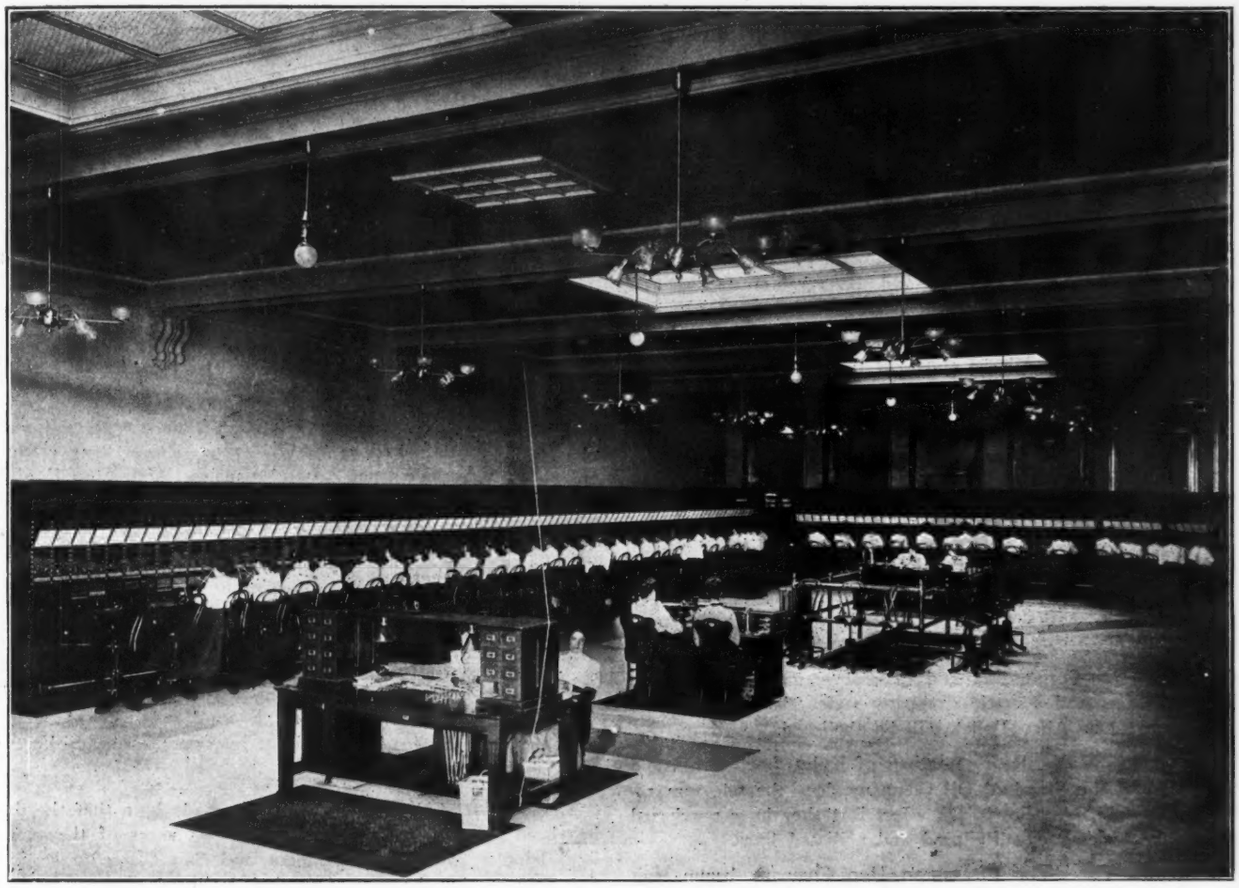
The new switchboards mark a new era in the development of modern, up-to-date telephone construction. They have already been installed in the new East "Central" Exchange Building recently completed on Hyde Street near Sutter, which provides for 9200 main lines, and also in the West "Central" Exchange Building, at the corner of Pine and Steiner streets to accommodate 10,100 main lines.

A fac-simile of the switchboard, a portion of which is shown in the illustration, will be installed in the new Main "Central" Exchange Building, now being completed on Bush Street opposite the California Hotel (which by the way is the largest building in the world devoted entirely to operating purposes.)

The switchboards provided for in this building, require a constant attendance of more than 400 operators. This "Central" will accommodate between forty and fifty thousand subscribers. The installation of the new switchboard at the South "Central" Exchange Building, on West Mission Street, near Eleventh, is now almost completed and will have a capacity of 18,400 main lines. In the four "Centrals" described 300,000 messages can be handled daily by the 1200 young women operators.

Under the new system, each operator has a designated number of telephone lines to answer, regulated according to the time of day and the number of switches made by the subscribers on her lines. This arrangement was impossible under the old system and insures prompt service and a noticeable saving of time in making the switches.

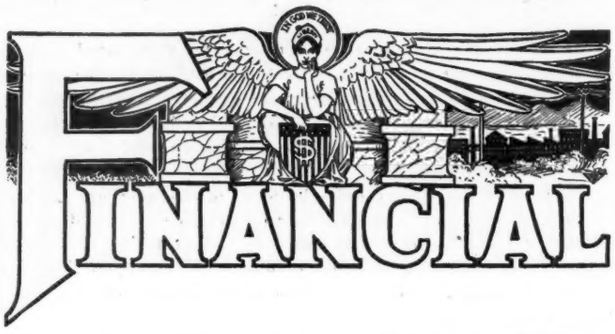
The cost of the general office building of the company on New Montgomery Street between Mission and Howard, which is now occupied exclusively by the executive offices, brings the aggregate cost of the improvements made by the Telephone Company in San Francisco alone to an amount considerably in excess of $2,500,000.



ONE OF THE FOUR NEW "MULTIPLE" SWITCHBOARDS BEING INSTALLED AT AN IMMENSE COST IN SAN FRANCISCO, WHICH WILL INSURE THE HIGHEST EFFICIENCY OF SERVICE TO ITS LOCAL PATRONS.

The enormous amount of material required in the construction of a switchboard is little realized by the public, and can only be shown by figures and comparisons. For instance, the board pictured on this page uses in its construction 5000 miles of copper wire, enough if stretched into one line to reach from San Francisco to London, England.

The telephone service is being interrupted more or less while the new system is being installed, and the completion of each new "Central" office will show a vast betterment in the general telephone service of the city, but the various "Central" offices are so inter-dependent that the highest efficiency will be reached only when all the projected improvements have been completed. The people of San Francisco will then receive telephone service that cannot be excelled, and equaled by but few cities in the world.



SAN FRANCISCO, CAL.—A decision has been given in the Geary-street railroad case by Superior Judge Frank J. Murasky in favor of the city.

NEW YORK, N. Y.—New York interests deny the reported deal for control of the street railways of Oakland by the United Railways of San Francisco.

LOS ANGELES, CAL.—The Pacific Gas and Electric Company has filed a certificate showing an increase of bonded indebtedness from $10,350,000 to $14,850,000.

LOS ANGELES, CAL.—One million dollars of the Los Angeles Pacific Company's bonds at 100¼ and accrued interest, placed on the market last Monday, were over-subscribed $90,000.

PETALUMA, CAL.—The Petaluma Power and Water Company has decided to issue $40,000 worth of bonds for the purpose of erecting a reservoir to have a capacity of several million gallons.

SAN JOSE, CAL.—The Peninsular Railroad Company has filed a complaint against F. E. Coykendall, H. G. Coykendall and others for a right of way over certain property belonging to the latter, or under their control.

SAN FRANCISCO, CAL.—A meeting of the stockholders of the General Electric Company of California will be held May 15th in San Francisco to consider the proposition of increasing bonded indebtedness from $7,500,000 to $9,000,000.

SAN FRANCISCO, CAL.—President John R. Britton of the California Electric Corporation and general manager of the San Francisco Gas and Electric Company states that the position formerly held by Allan Pollak will be abolished.

NEW YORK, N. Y.—Representatives of Kuhn, Loeb & Co. and an official of the Standard Oil Company deny the telegram received from Los Angeles to the effect that they have purchased the Los Angeles-Pacific Railroad and affiliated lines.

OAKLAND, CAL.—The Pleasanton Hop Company begun suit against the Spring Valley Water Company of San Francisco, asking for $100,000 damages for the diversion of percolating waters and for a restraining order to prevent further damage.

SAN FRANCISCO, CAL.—Three thousand acres of land, including a portion of the town of Inverness, were bought this week by the Inverness Land and Water Company from Julia Shafter Hamilton for a consideration said to have been approximately $160,000.

SAN FRANCISCO, CAL.—The report of Engineer Russel H. Dunn for the Spring Valley Water Company has been filed with the Board of Supervisors. It places the net total value of the property at $24,284,814. The gross income for the year is placed at $2,226,260.

SAN FRANCISCO, CAL.—The Board of Supervisors have passed to print resolutions reducing the rates of water to house consumers between 10 and 11 per cent from the present classified rates, and fixing the rate of gas to the consumers at 85 cents per 1000 feet.

STOCKTON, CAL.—E. H. Rollins of Boston, G. A. Bacheldor and W. A. Catell of San Francisco and J. Taylor of Chicago have inspected the Stockton street lines recently built by the Central California Traction Company. The visitors are interested in the company's bond issue.

NEW YORK, N. Y.—Four hundred and eleven thousand shares of the Philadelphia Company's common stock have been deposited under the plan for the purchase of a controling interest by the United Railways Investment Company. The directors have decided to purchase the entire amount of stock deposited.

PORTLAND, ORE.—The United Railway Company was on March 15th granted a franchise by the City Council for a trunk line electric railroad connecting the railroad depots in the north end with those in the south end. The franchise is for twenty-five years granted in Portland. The consideration for the franchise is $150,000.

ANAHEIM, CAL.—The City Trustees have called a bond election to vote on a proposition to issue bonds to the amount of $69,000 for municipal improvements on March 14th. This includes $23,000 for the extension and improvement of the water system, $25,000 for an electric lighting plant and $75,000 for a gas generating system.

SAN FRANCISCO, CAL.—The secretary of the Northern California Power Company reported at the annual meeting, held March 19, 1906, that the gross earnings of the company amounted to $185,024.40, and that the operating expenses amounted to $113,549.13, the net earnings for twelve months being $75,414.40. The surplus on March 1st was $141,596.

LOS ANGELES, Cal.—At the meeting of the Monterey County Gas and Electric Company the following officers were elected: C. W. Allen, president and general manager; Mrs. Cora E. Hubbel, vice-president; R. C. P. Smith, secretary-treasurer. Mr. Allen, who was local manager of the company's interests at Monterey, succeeds J. M. Gardiner as president and J. C. Hill as general manager.

SAN BERNARDINO, CAL.—At the annual meeting of the San Bernardino Valley Traction Company held this week A. C. Denman secured entire control. The following directors were elected by the Denman interests: A. C. Denman, Jr.; Geo. M. Coolley, E. D. Roberts, W. L. Brookins and J. S. Wood. The following directors were chosen by the Fisher interests: Henry Fisher, E. S. Graham and O. Collins.

SAN RAFAEL, Cal.—The statement is made here that the deal has been closed for the purchase of 1003 acres of the marsh land lying between Corte Madera and San Clemento stations for $100,300 by the Bay Counties' Railroad Company. The land belonged to Francis Valentine and will be reclaimed by the Bay Counties Railroad Company and used by it for freight yards and a machine shop site.

SACRAMENTO, CAL.—Judge J. W. Hughes has handed down a decision in favor of the State against the Sacramento Electric, Gas and Railway Company, in which he holds that the State has a right to all the water at the first fall in the canal at Folsom Prison, and that the company had no right to place a shutter on the gate at the head of the canal to conserve the water at the dam for its own use.

NEW YORK, N. Y.—The United Railways have just completed the audit of the Philadelphia Company's books for the year 1905. The gross earnings are found to be $15,900,000. The surplus for common stock, after preferred dividends have been paid and over $500,000 set aside for improvements, amounts to $2,100,000, equal to more than 7 per cent on the common stock. The earnings for January and February this year increased $226,000, equal to 7 per cent increase over 1905.